SEPTEMBER 1960

Power Engineering

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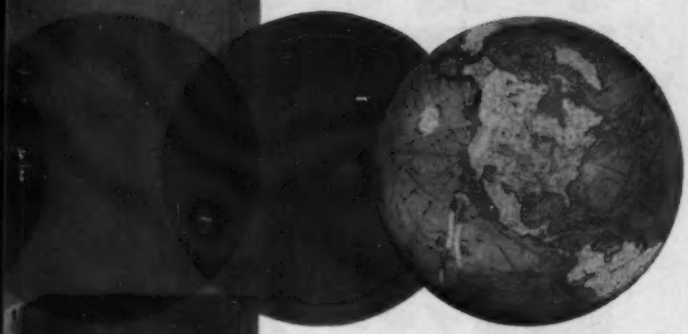
IN EVERY FIELD WHERE POWER IS USED

BREED PLANT



World's Largest Boiler

GOES ON LINE

Serving 475,000 Kw turbine, B&W supercritical Universal Pressure® Boiler now in service at Breed Plant.

The biggest boiler ever built . . . capable of generating about 4-billion kilowatt hours annually, enough electric power for more than 1,000,000 average American homes . . . is now on the line at the Breed Plant of the Indiana & Michigan Electric Company on the American Electric Power System.

Operating conditions are: 3500 psi at 1050/1050/1050 F. To get some idea of the output of this new supercritical pressure unit just compare the famous Hoover Dam. Kilowatt hours produced at the Breed Plant are about equal to the amount produced annually at Hoover Dam . . . yet the cost of putting this plant on stream (per kilowatt of electricity) will equal about 1/6 that of building a new Hoover Dam today.

This is the second Universal Pressure Boiler to go on the line . . . and there are more on the way. As at the Breed Plant, products of Babcock & Wilcox engineering and research will help utilities and industry to meet the challenging growth of the future . . . The Babcock & Wilcox Company, Boiler Division, Barberton, O.

B&W

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Unmistakable water level readings are assured with Diamond's MP-3000 Multi-Port Bi-Color Gauge, equipped with condensate by-pass. A major reason for such performance is the unique and exclusive by-pass which traps any condensate before it reaches the port channel. The absence of condensate in the port channel assures a distinct bi-color image — red for steam, green for water. Regardless of operating pressure, there's a Diamond Gauge to provide accurate water level readings. Write for complete information or contact your local Diamond representative.

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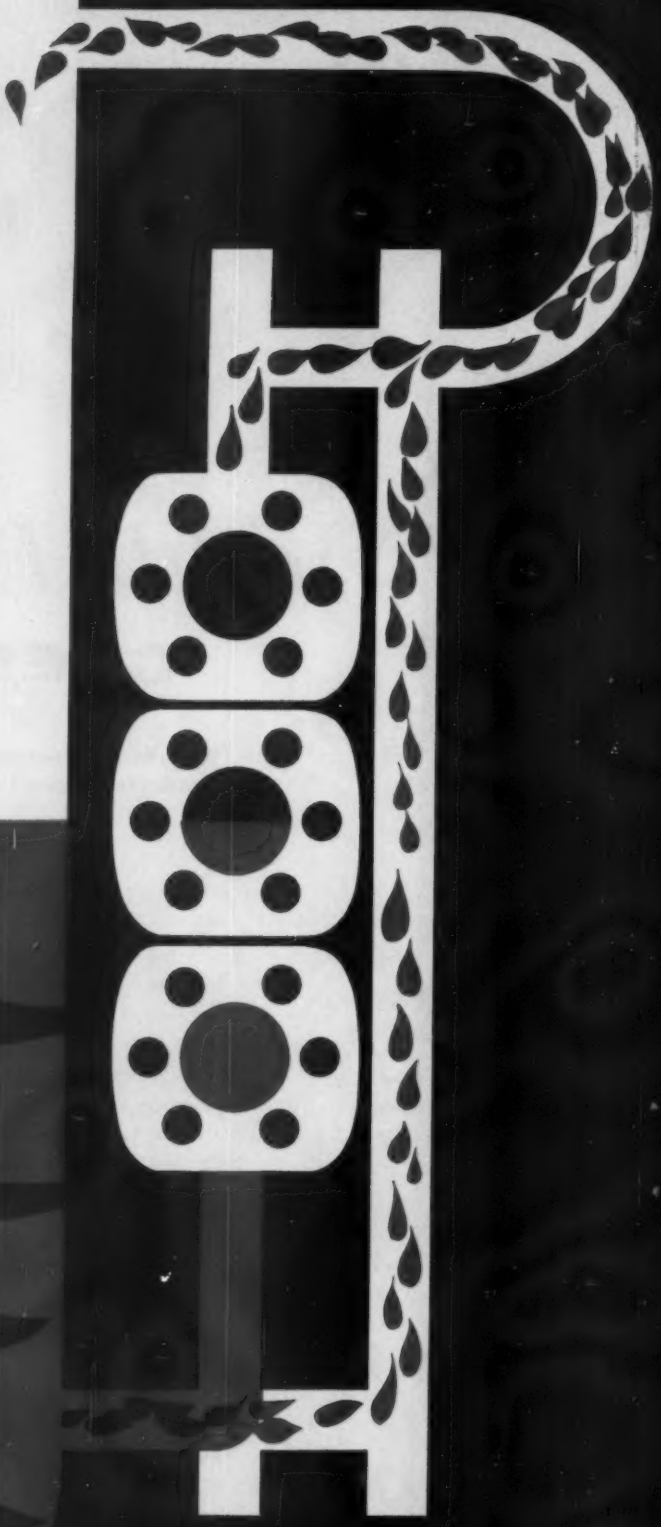

Kingsley L. Rice
1898 - 1960

WITH a deep sense of loss of an inspiring leader and a staunch friend, the entire staff of Technical Publishing Co report and mourn the death of the company's president, Kingsley L. Rice, at his home in Winnetka, Illinois, on the morning of August 16. He was just ending his 62nd year, and had been ill only a short time. His passing was a shock to us all.

Mr. Rice was born in Barre, Massachusetts, the son of Arthur L. Rice, one of the founders of Technical Publishing Co, and for many years editor of Power Plant Engineering, now POWER ENGINEERING. He moved his family to Wilmette, Illinois in 1903. Kingsley Rice attended local public schools, then spent two years at the Northwestern University School of Engineering, followed by two years of military service, and then was graduated from Northwestern in 1920 with a degree of B.S. in Economics.

In 1920 he became a fire-insurance engineer with Missouri Inspection Bureau, and in 1922 joined the circulation division of Technical Publishing Co. He served successively as assistant circulation manager, assistant treasurer and vice president, and in 1938 was elected president of the company.

In his successive functions in the company, Mr. Rice exhibited executive ability and knowledge of the publishing business in the highest degree. He always looked forward, met obstacles with humor and patience, fostered policies that have made the company the publisher of four outstanding national magazines in the past 12 years, and established it as owner of its own publishing headquarters in Barrington, Illinois. He was also Chairman of the Board of Rice-Youmans Publ. Co.

His interest in, and first-hand knowledge of, every phase of the publishing business has resulted in his numerous services to the whole industry. For example, during World War II he was selected to set up and serve on the editorial advisory board of the Office of Censorship in Washington, on problems involving engineering journals. He was past-president of the Associated Business Papers, and was currently a member of the board of directors of National Business Publications, past president of Chicago Business Papers Association and a member of Association of Industrial Advertisers.

Mr. Rice was active in the civic and recreational activities of his home town and of Chicago's North Shore. He was a member of the Indian Hill Club, National Press Club, the University Club of Chicago and Delta Upsilon social fraternity.

Engineers' Preview

OF NEWS AND COMING EVENTS IN THE POWER FIELD

WORLD'S LARGEST electric power generating unit is now in commercial operation. It's the 475,000-kw turbine generator at Indiana & Michigan Electric Co's single-unit Breed Plant in Sullivan County, Ind.

Under construction since 1956, the plant is located on the east bank of the Wabash River about 20 miles southwest of Terre Haute. It is tied into the I. & M. and AEP power systems by a 186-mile, double-circuit 345,000-v transmission line extending to a new substation west of South Bend. Total cost of the plant is estimated at $71.5 million.

Design calculations are that the unit will have a thermal efficiency represented by the consumption of 8535 Btu per kwh generated, or an anticipated thermal efficiency of 40 per cent.

GIANT cooling tower rising 320 ft above the ground — reportedly the first of its kind ever used in the Western Hemisphere — will be built adjacent to Kentucky Power Co's new Big Sandy Plant near Louisa, Ky. Tower will be built by The Marley Co. It will be hyperbolic-shaped and erected on a stilt-like structure. (See POWER ENGINEERING'S articles, Hyperbolic Towers Deserve Study, pages 96–97, June, 1959; and Still More on Hyperbolic Cooling Towers, pages 74–75, May, 1960.)

Shell of the circular tower, of reinforced concrete, will be 320 ft high, 245 ft in diameter at the base, tapering to 130 ft at its narrowest point near the top, then widening again to 140 ft at the top. Bottom 10 ft of the tower will be open, except for concrete columns on which it will rest, to provide passage for the tremendous amount of cooling air required.

Hot circulating water coming from the plant's condenser will be pumped into the tower at a level 40 ft above its base, from which point it will fall through wooden packing. Here, heavy masses of air, drawn up by the draft action of the tower, will evaporate a small percentage of the hot water and so cool the balance. In service the tower will supply 120,000 gpm.

USING sound-absorbing panels, Westinghouse has obtained a reduction in noise level of 6.3 decibels for the Arizona Public Service Co's 25,000/33,333-kva power transformer. Noise reduction was accomplished in the field by first mounting thin metal panels on rubber blocks on all four sides of the transformer from the base to the cover. Then sound-absorbing material was placed between the outside panels and the main tank and is held in position by clips which are cemented to the tank wall.

BABCOCK & WILCOX report shipment of the world's first shop-assembled boiler fired by carbon monoxide. Named the PAC-CO, the 64-ton package unit was lifted aboard the vessel Cap Bona Vista for her voyage to Montevideo, Uruguay, from the port of Wilmington, North Carolina. The boiler will be part of a refinery extension, and will operate at a steam pressure of 600 psi and a temperature of 750 F. During normal operation, it will generate 30,000 lb of steam per hour while burning both oil and carbon monoxide, with 23,000 lb of steam being generated from the otherwise waste regenerator gases. When firing oil alone, the unit will produce 43,000 lb/hr of steam.

DEEP-PENETRATION radar beams may soon help to unlock trapped oil reserves jellied in rock thousands of feet beneath the earth's surface. Raytheon Co has under development an electronic oil well heater which may aid in the recovery of some of the vast oil reserves which cannot be brought to the surface by present methods. Raytheon engineers will package 5000 to 10,000 watts of power into a capsule just six inches in diameter so that the experimental device can be lowered into a low-producing well in northwestern Montana, site of the first field tests. The well selected for the first test is 3500 ft deep. Subsequent tests will be conducted in wells of other depths and formation types.

MEETINGS: Association of Diesel Specialists, annual convention, will meet at the Sherman Hotel, Chicago, beginning September 22.

General Electric's second annual turbine seminar is scheduled for September 22, Hotel Roosevelt, New York City.

Water Pollution Control Assn's annual meeting will be held in Philadelphia, Convention Hall, Oct. 2–6.

ASCE's annual meeting will be in Boston, Statler-Hilton, Oct. 10–14.

Third National Conference on the Application of Electrical Insulation will be held Dec. 5–8 at the Conrad Hilton Hotel, Chicago. AIEE and NEMA are co-sponsors.

International Institute of Welding will hold its first Assembly in the U. S. April 10–21, 1961.

POWER ENGINEERING is published monthly at 308 E. James St., Barrington, Illinois; DUnkirk 1-1840. Subscription information: Published monthly, price in U. S. and possessions $10 per year; in Canada $11 per year; other countries $12 per year; single copies $1. Accepted as controlled circulation publication at Concord, New Hampshire. Change of address: Send to POWER ENGINEERING, Circulation Division, Barrington, Illinois. Please supply your position title, company name, company address. Please allow 60 days to make the change effective.

The outer low-voltage coil of copper strip being wound. The "progressive" coil winding method uses a low-high-low coil grouping, and the flat copper leads from the inner low-voltage coil, also of copper strip, can be seen just above the shaft. Note paper, with resin applied "barber-pole" fashion, being fed in below copper strip. As both high- and low-voltage coils use the same electrical centers, the winding has better electrical balance and inherently higher resistance to short-circuit forces.

Strip-copper transformer windings help improve performance—cut size and weight

New coil designs using copper strip have helped extend the range of pole-mounted distribution transformers through 500 Kva—and to shrink miniature transformers for electronic use by 1/3 in size and weight. In both cases, operating characteristics were improved at the same time.

WESTINGHOUSE ELECTRIC CORP. has made the significant advance in the distribution transformer field through a combination of new coil and core design. For ratings of 75 Kva through 500 Kva, the company devised the new "progressive" winding method. Using a low-high-low coil grouping, individual coils are wound one on top of the other, with the required amount of epoxy-resin-coated paper insulation wound between layers and coil groupings. The inner and outer low-voltage coils are wound with strip copper the full width of the wire space. High-voltage windings are simple layer-wound coils of rectangular wire. All elements are wound with carefully controlled tension to produce a tight, solid coil.

During subsequent drying and vacuum treatment, the epoxy resin on the paper is bonded to the strip copper and the coil layers. The entire winding becomes a rigid, self-supporting structure, with strength to withstand high short-circuit stresses. Hence external coil bracing, an important weight and space factor in previous design, is completely eliminated. The new windings make a notable contribution (about 9% for the 167 Kva unit) to the total weight reduction.

Anaconda technical specialists worked closely with Westinghouse engineers during the development of the "progressive" winding method and The American Brass Company is supplying high-quality copper strip, deburred, and finished to half commercial tolerances in width and gage. It also designed special packaging to protect the strip during shipment and in handling.

AT THE OTHER END OF THE SCALE, extremely thin gage copper strip or foil has helped to miniaturize transformers to the level of other electronic system components. Because of its high electrical conductivity, and optimum stacking factor, the copper strip can be wound into extremely compact ribbon-type wafer coils that reduce the weight and volume of transformers about one-third.

TECHNICAL ASSISTANCE. Whatever the application, if you are investigating the advantages of winding coils with copper strip or "Electro-Sheet" electro-deposited copper foil, metallurgists and technical specialists of The American Brass Company are available to work with you in selecting the proper materials, including coatings, in the lamination of insulations. For such assistance see your American Brass representative, or write: The American Brass Company, Waterbury 20, Conn. 6074

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Tracers

COMMENT, OPINION, AND NEWS ABOUT PEOPLE

▶ **Lucien R. Greif** of Greif-Associates in New York, writes us:

> We like your new format!

Reader **William Edward Bullock** of Freeport, N. Y., comments:

> Congratulations on your July, 1960 issue. The paper is getting better all the time.

From Allis-Chalmers, **John L. Black** writes:

> We were all very pleased with the July issue. . . . You and your staff have done an excellent job in improving a book that to my way of thinking was excellent to start with. The treatment of the Austin article was tops.

Another reader — a highly respected Editor in the power field — has this to say:

> I have just received the July issue of POWER ENGINEERING, and my first reaction is that the new layout is an artistic success, resulting in a very pleasing appearance. . . . I like the symbolic representation of an open square and a rectangle which you have used at the beginning of several articles. . . .
>
> As far as half-tone illustrations are concerned my feeling is that a black-and-white print is just that, and that a color tone or screen really does very little for it. . . . By far the most effective use of color in this issue, in my opinion, is found on page 59 and pages 70–71. Especially on page 70, the use of color makes far more intelligible a drawing that is extremely confusing in black and white alone. I also think that the layout in the Handbook section is especially effective.
>
> Over the years I think that POWER ENGINEERING has done an especially attractive job in the two-page spread entitled News Reel. The one thing that I think has been missing is the extended technical article that treats a subject in depth. . . . I really do believe that the technical prestige of the magazine would be enhanced by the publication of such articles at intervals of every other month or so.
>
> One final comment on a pet subject of mine. I hope you will continue the effective job of book reviews that has always been an interesting feature of POWER ENGINEERING to me.

▶ **E. E. Cobb,** supervising project engineer of Gibbs & Hill, consulting engineers, has a helpful word to contribute to a question raised here:

> I note in your July issue of POWER ENGINEERING that W. E. Hoffman requests information about the manufacturer who builds a balloon device made of Neoprene for installation in coal hoppers to break jam-ups.
>
> This device is also made in the United States by Gerotor May Corp, Cockeysville, Md, and the trade name in Pneubin.

▶ **H. R. Drew,** director of research for Texas Electric Service Co of Fort Worth, has described a method of treating salt or brackish water so that it becomes a drinkable part of a city's water supply. Speaking recently at ASME's semi-annual meeting in Dallas, Drew explained the process known as electrodialysis, by which it may be possible to produce drinkable water from moderately salty sources for about 30 to 50 cents per 1000 gallons.

> The process can be described simply as placing permeable membranes in water between electrodes. When a current is run through the electrodes, electrically charged particles of salt move to one electrode. The membrane, which allows only one-way traffic, prevents them from moving back into the water solution again. One stream of water loses the salt, while another stream picks it up.
>
> A major advantage of electrodialysis is that it is relatively simple and does not require large machinery or complicated heat exchangers. Cost depends on the salinity.

▶ City of Boston is reportedly saving about $50,000 annually by conserving the gaseous products of combustion of its new 900-ton capacity South Bay Incinerator designed by Metcalf & Eddy and using them to generate steam for the Boston City Hospital. Heat from the incinerator's six furnaces are fed to three waste heat boilers to generate the steam which is then piped to the hospital. In addition, during low demand periods at the hospital, the Boston Edison Co proposes to purchase excess steam for distribution.

▶ **William Henry Byrne** of New York has been nominated to be the 80th president of ASME. A consulting engineer, Byrne is owner of Byrne Associates, Inc, and Stevens and Wood, Inc, New York, N. Y.

John F. Ring has joined Ebasco Services, Inc, as gas engineer in the consulting engineering dept.

E. J. Kleine has been assigned as an application engineer to Allis-Chalmers' regulator dept, and **Gerald Lesiecki** as an assistant engineer to the compressor dept.

Harold A. Webster, president of the National Electrical Contractors Assn, has been elected chairman of the 1961 National Electrical Week, to be held Feb 5–11 to call attention to the importance of electricity to our economy and progress.

Clarence H. Linder of New York, a GE vice-president, is the 1960–61 president of AIEE. Linder was recently named head of GE's electric utility group.

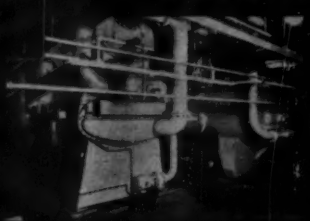
▶ **George R. Strandberg,** retired consulting engineer of Stone & Webster Engineering Corp and a noted hydroelectric engineer, died recently at the age of 71.

Albert Haertlein, Associate Dean of Engineering and Applied Physics at Harvard, died in his Harvard office on June 7. He was 64.

modern times . . .

*photos courtesy Baltazar Korab

Mr. Alfred C. Lamb, Director of Buildings Services, is shown with large absorption refrigeration system used in air-conditioning Wayne State University.



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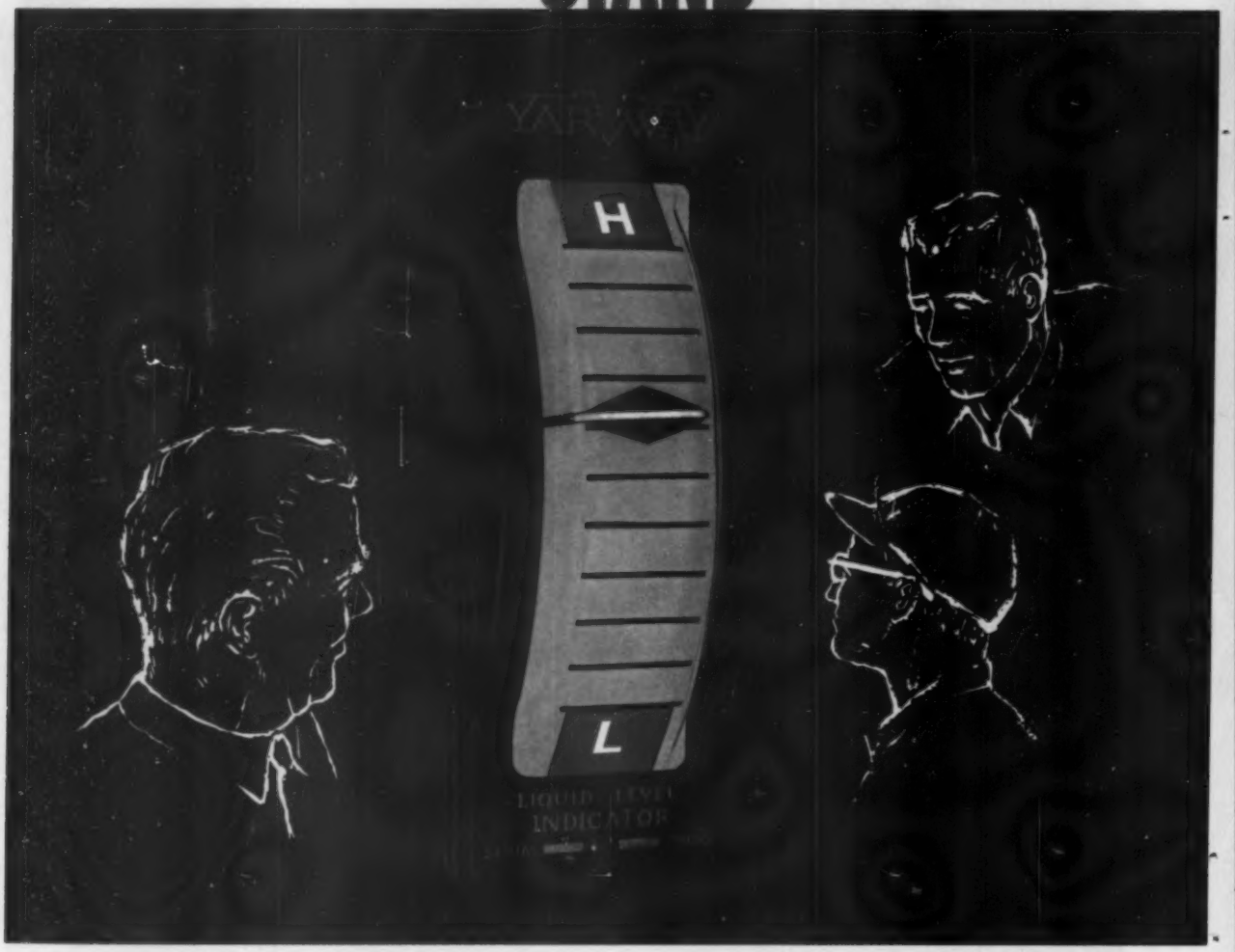

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(Code Case #1155 Installations)

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PENNSYLVANIA ELECTRIC CO. (ERIE, PA.)
OMAHA PUBLIC SERVICE
CENTRAL ILLINOIS ELECTRIC
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WATER LEVEL INDICATION ?

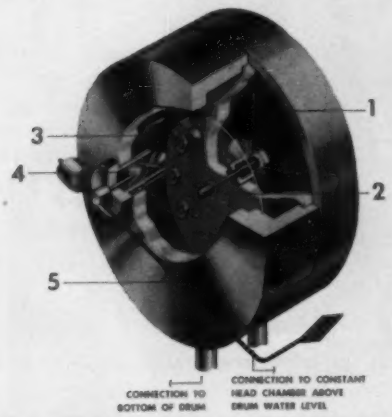
YARWAY REMOTE INDICATORS HAVE BRILLIANT "WIDE ANGLE" VISIBILITY... CAN BE INSTANTLY READ FROM MULTIPLE VANTAGE POINTS

Yarway Remote Liquid Level Indicators bring distant, often hard-to-see boiler level readings right down to eye level on the panel board or other convenient location.

No matter where you stand—at any point in a 180° arc, and from a considerable distance—the brilliant new wide vision dial makes viewing and reading easy.

GIVE INSTANT, ACCURATE READINGS BECAUSE INDICATOR IS OPERATED BY THE BOILER WATER ITSELF

Remote readings of levels in boilers (also feed water heaters and other heat exchangers) are instant and accurate because indicator *operating mechanism* is actuated by the varying head of the liquid itself, yet the *pointer mechanism* is never under pressure.



Constant pressure from a controlled-temperature constant head chamber located above drum level is maintained on one side of diaphragm (1) in indicator. Varying pressure changing with water level is maintained on opposite side of diaphragm. Change in differential between the two pressures moves the diaphragm which in turn regulates, through deflection plate (2), magnet (3), and spiral magnetic armature (4), the position of the counterbalanced pointer (5).

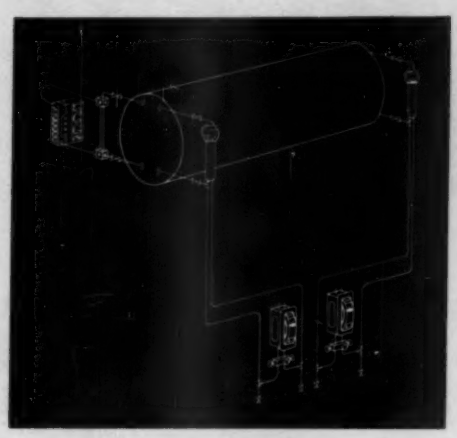
OPERATE ADDITIONAL REMOTE SIGNAL ALARMS, HORNS OR LIGHTS

With the addition of a control unit Yarway Indicators may be equipped to operate auxiliary hi-lo signal alarms, horns or lights located at any place in the plant. Electronic secondary indicators may also be used to duplicate readings at remote points.

FULLY APPROVED AS PRIMARY INDICATING ELEMENTS UNDER BOILER CODE CASE #1155

Under A.S.M.E. Boiler Code Committee ruling in Case #1155, two independent remote level indicators of compensated manometric type may be used instead of one of two required gage glasses for boiler pressures 900 psi and above. When both indicators are in operation, the gage glass may be shut off but shall be maintained in serviceable condition.

Yarway Remote Liquid Level Indicators conform to this ruling and are used widely for primary boiler water level indication in plants operating at 900 psi and above.



All Yarway Indicators for service over 700 psi are temperature-compensated; pressure compensation available when desired. Use of controlled-temperature column on constant head chamber fully protects against system upsets.

If you would like a reprint of this Boiler Code ruling, just ask for Case #1155 reprint.

Get the full story on Yarway Liquid Level Indication for your plant. Write for new 24-page Bulletin WG-1825.

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- **Use of smaller fan size possible on many direct-connected installations.**

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'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

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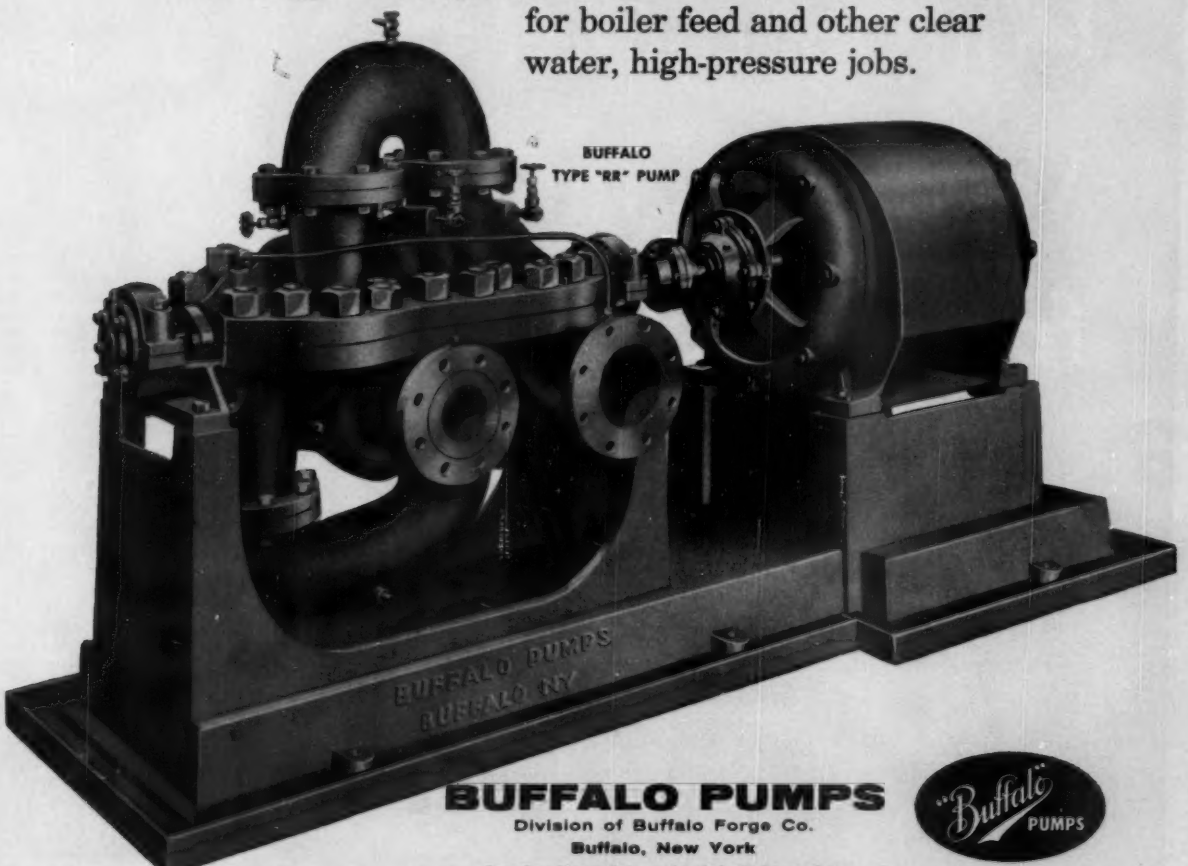

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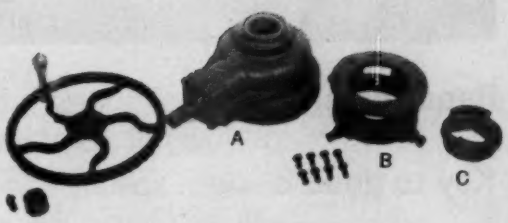

Only three parts needed to convert your OS & Y valve to gear operation: (a) Crane Converto-Gear Operator, (b) adapter for mounting operator on valve, (c) yoke sleeve adapter. Handwheel and mounting bolts furnished with conversion kit.

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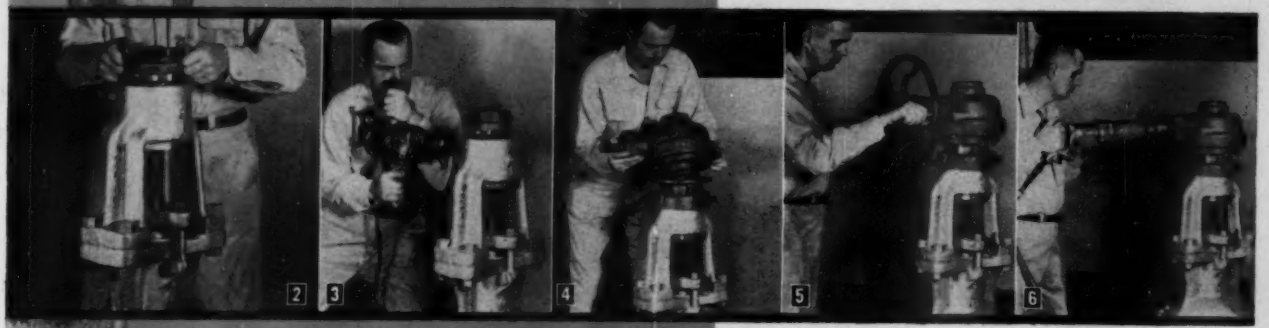


To convert your OS & Y valve, (1) remove the handwheel, (2) mount the yoke sleeve adapter, (3) countersink 4 holes for the Converto-Gear adapter, (4) bolt the adapter in place and attach your Crane Converto-Gear Operator, (5) and you're ready for smooth, manual operation, (6) or fast operation with an air or electric power operator.

For more data circle 508 on Post Card

See why ALCOA ALUMINUM makes a good design habit

Requirement: metal pipe and tube to insure corrosion-free fluid handling at low initial cost and minimum upkeep

Key to good design: specify low-cost, trouble-free tubular products of Alcoa Aluminum

The overpowering volume of pipe and tubing needed in the process industries makes it one of the biggest single material investments in most plants. Historically, the repair, maintenance and replacement of piping systems has been too, one of the biggest causes of an alarming increase in maintenance costs. Both factors make vital a clear understanding of the rather remarkable advantages of aluminum pipe and tube.

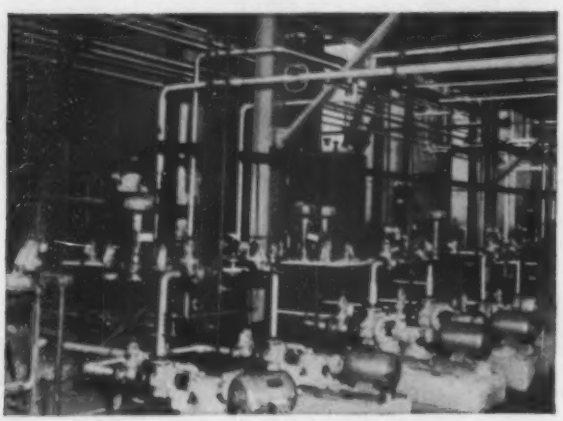
First of all, from a cost standpoint, aluminum is very frequently the lowest cost material suitable for a wide variety of applications in moving fluids through a plant. Consider, for example, the fact that the initial cost of aluminum may often average as much as 50 per cent less than that of admiralty for identical applications. Even greater savings apply when other metals such as stainless or mild steel are compared with aluminum.

Beyond these initial cost savings, aluminum provides significant maintenance benefits. For instance, no other commonly used metal offers aluminum's great resistance to corrosion. And the corrosion resistance for specific alloys exposed to particular environments can be determined from a substantial body of factual service data accumulated by ALCOA over the past 40-odd years.

It is hardly surprising that aluminum, in a variety of tubular forms, is gaining the confidence of more and more designers and builders in the process industries . . . as suggested by the aluminum applications described on these pages. ALCOA's engineers are anxious and willing to share their factual knowledge of aluminum which inspires this confidence. They are doing so through a series of engineering conferences being held this year in major cities around the country. Your local ALCOA sales office will be happy to furnish details.

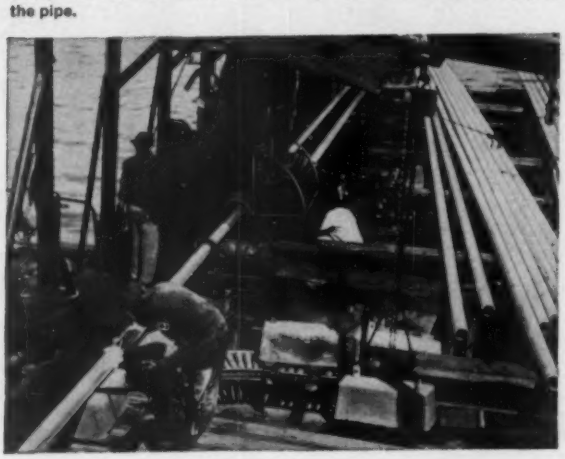
You may also wish to avail yourself of the body of ALCOA literature which describes in technical detail the known performance characteristics of aluminum in a variety of process industries applications. Simply fill in and mail the coupon opposite.

World wide sales through ALCOA INTERNATIONAL, INC., 230 Park Avenue, New York 17, N.Y.



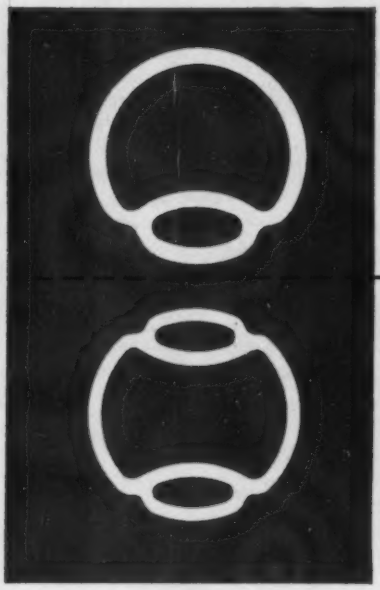
Process piping of Alcoa Aluminum is shown here in a system designed to handle liquid sugar. The natural corrosion resistance of aluminum prevents contamination of the syrup, insures long service life and prevents excessive maintenance. Its scavenging action reduces undesired heavy metal contamination, thereby improving the end product. And aluminum's low friction factor permits fast flow without excessive pumping costs.

This aluminum pipeline is shown being welded and laid in Lake Maracaibo, Venezuela. Aluminum—without special coatings—has proved highly suitable for this operation because it resists so well the corrosive attack of the brackish waters in the lake. Since no coating is required, the low initial cost of the aluminum has proved a significant benefit. The light weight of the aluminum pipe speeded laying operations, and it has no vulnerable coating which would require babying the pipe.



Alcoa Aluminum jacketing keeps the thermal insulation on these large diameter steam lines fully effective. The light, bright aluminum jacketing shields over 5½ miles of piping and insulation from rain, snow, dirt and ice while providing effective protection against a highly corrosive industrial-marine atmosphere.

New UNISTRENGTH® pipe by Alcoa now makes it possible to design low-cost welded aluminum lines with uniform bending, bursting and tensile strength throughout their length. The secret is a reduction in wall thickness everywhere but at the ends where it is needed to overcome the local reduction in strength caused by the heat of welding. The result is aluminum piping which weighs up to 40% less but provides equivalent design strength.



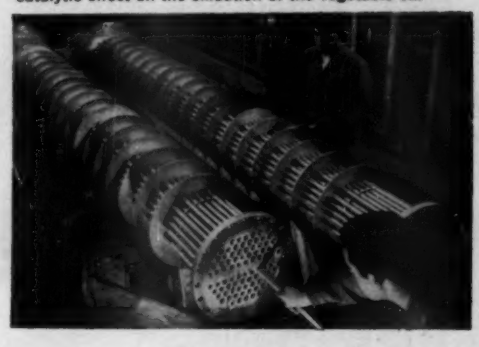
Alcoa UNITRACE® is the light, strong, corrosion resistant pipe which provides steam and product passages in a single extruded unit. It has proved an excellent way to cut cost and improve the efficiency of steam traced lines—by eliminating costly external steam jackets or inefficient tracer tubes. Now a new product,

Alcoa DUOTRACE* makes possible the same important benefits in steam traced systems where recirculation is desirable. As shown, DUOTRACE provides two trace passages plus the product passage in one extruded unit. Flange and Trace Cap fittings compatible with conventional piping are available for both UNITRACE and DUOTRACE.

Design Note: Consider UNITRACE and DUOTRACE as low-cost successors to both heat exchangers and preheaters.

*Trademark of Aluminum Company of America

Alcoa Aluminum heat exchanger tubing is frequently the lowest cost material with suitable corrosion resistance for a variety of heat transfer applications. Moreover, aluminum frequently displays significant extra benefits—as in this pair of aluminum oil-to-oil exchanger bundles for preheating vegetable oils. Here, the aluminum alloys have no catalytic effect on the oxidation of the vegetable oil.



Aluminum Company of America, 876-J Alcoa Building, Pittsburgh 19, Pa.
Please send me the following literature covering Alcoa Aluminum for tubular products and other uses in the process industries:

- ☐ 10197 Aluminum Pipe and Fittings
- ☐ 34-10418 Alcoa Unitrace: Combines Piping and Tracing in One Unit
- ☐ 10270 Alcoa Utilitube
- ☐ 10460 Process Industries Applications of Alcoa Aluminum
- ☐ 20849 Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres
- ☐ 20265 Have You Tried Aluminum in your Refinery?
- ☐ 20437 Aluminum Alloy Heat Exchangers in the Process Industries
- ☐ 20272 Aluminum Alloys for Handling High Purity Water
- ☐ 21090 Resistance of Aluminum Alloys to Fresh Waters
- ☐ 10130 Forming Alcoa Aluminum
- ☐ 19416 Brazing Alcoa Aluminum
- ☐ 19415 Welding Alcoa Aluminum
- ☐ 19051 Alcoa Aluminum Handbook

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ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

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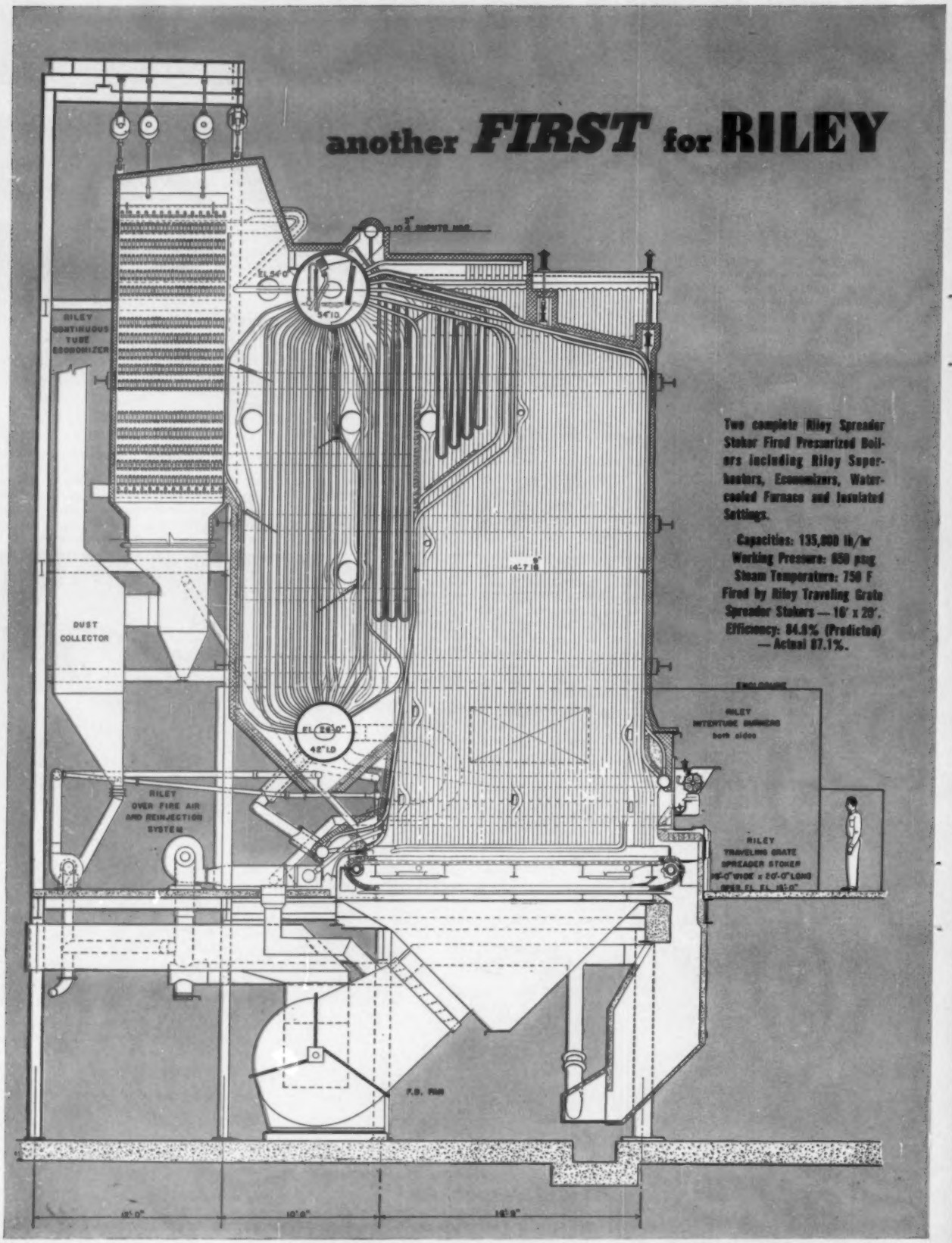
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Two complete Riley Spreader Stoker Fired Pressurized Boilers including Riley Superheaters, Economizers, Water-cooled Furnace and Insulated Settings.
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A Survey Of Your Plant by A Qualified Consulting Engineer Can Show You Ways To Make

..two PRESSURIZED
Spreader Stoker Fired Boilers perform successfully for Deere & Company

The lower operating cost resulting from pressurized operation is due to:

- Elimination of induced draft fan and its maintenance.
- Simplified combustion controls.
- Full furnace wall heat absorption and elimination of cold air filtration into setting.

During the recent decade pressurization of furnaces of industrial and utility type boilers has become a general practice, particularly with gas and oil fired units. A few pressurized pulverized coal fired boilers have been installed. Riley Stoker Corporation has been a leader in the pressurized boiler field. The most recent Riley achievement in boiler furnace pressurization is the *first* successful operation of two 135,000 lb/hr pressurized spreader stoker fired boilers recently installed in the new Central Power Plant of Deere & Company which serves the three John Deere factories in Moline, Illinois.

Operating efficiencies of up to 87% (over 2% higher than was predicted conservatively by Riley engineers) are attained with this first Riley Pressurized Spreader Stoker Fired Boiler. Here is another fine example of why it pays to rely on the combined experience of Riley boiler and stoker equipment engineers.

For a full written report on the new Deere & Company Central Power Plant prepared by Mr. Howard H. Reisman, Manager, Power Plant Engineering Division, Deere & Company, write to
RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS

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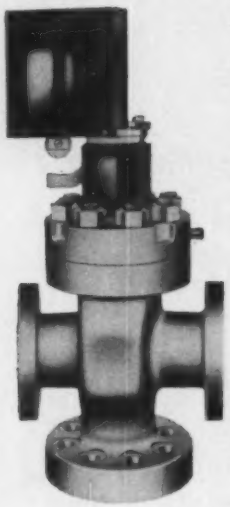
power

CONSOLIDATED ELECTROMATIC® RELIEF VALVES

conserve power, increase efficiency in H-P, H-T boiler operation



Consolidated Electromatic Relief Valve. Sizes 2½" to 14". Pressures to 3000 psi. Temperatures to 1120° F. Double outlet.

conserved

Automatic, electrically-actuated Consolidated Electromatic Relief Valves assure more accurately balanced boiler operation at peak loads and more uniform line pressure.

The Electromatic protects the superheater at start-up. It may be actuated manually at any pressure to provide greater steam flow during start-up and to minimize the possibility of burning the superheater tubes due to trapped condensate or hot spots. Safety valve seats and turbine components are protected by using the Electromatic to purge scale, weld splatter, and other foreign matter.

With the Electromatic set to open before any of the safety valves, its 1% blowdown handles line pressure surges without lowering the operating pressure. Power is conserved and boiler efficiency increased.

You can also reduce maintenance by setting the Electromatic to operate before the safety valves. It becomes the working valve and since a gate valve can be installed under the Electromatic, it can be isolated in case of damage and repaired while the unit is on the line.

Conserve power and increase the efficiency of your steam generating plant. Get complete details about all the elements in Consolidated Electromatic Relief Valve System.

Write for Bulletin 720.

MANNING MAXWELL & MOORE INC. TRADE MARK

CONSOLIDATED SAFETY VALVES

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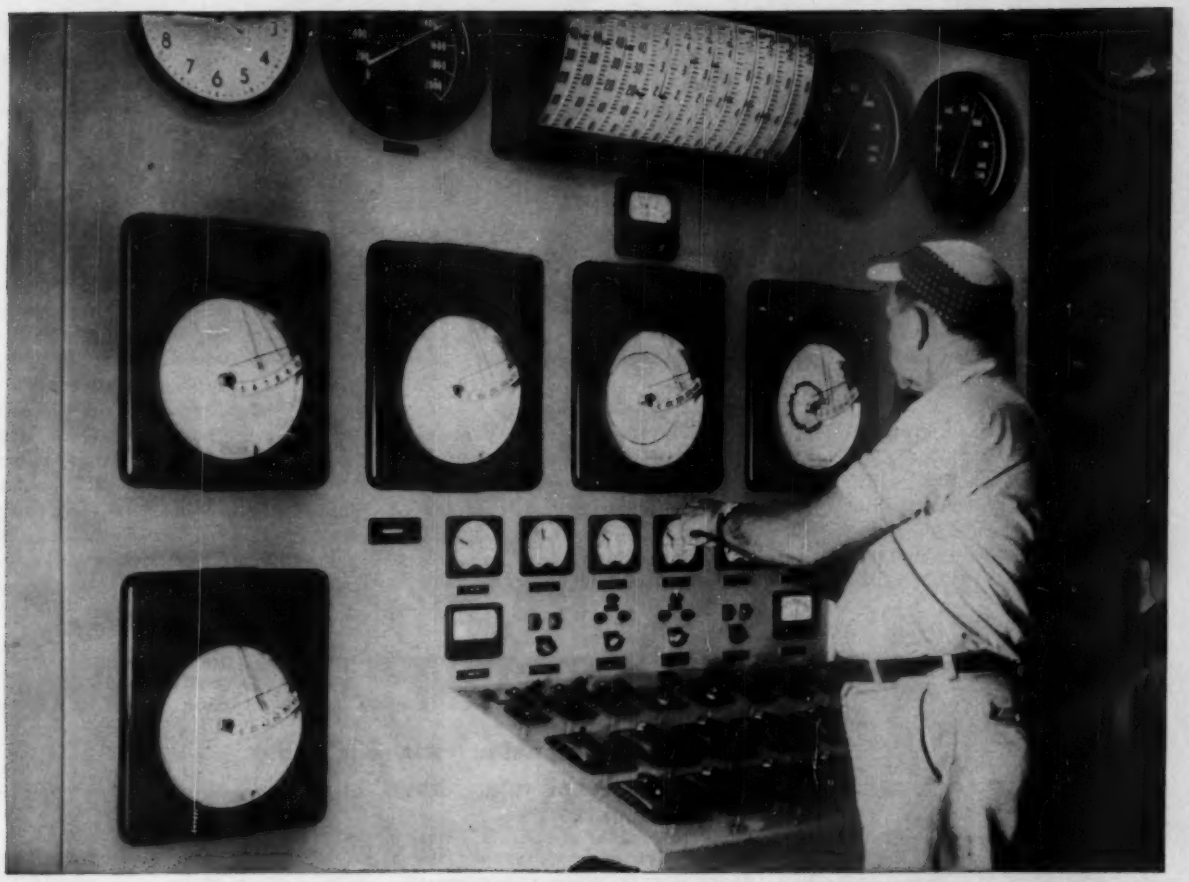

Control Room for Cyclone Furnace Boiler at Mathews No. 2 Power Plant of Greenwood Mills, Greenwood, S. C. Bailey MINI-LINE System concentrates controls at operator's station.

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Your operators can work more efficiently, make adjustments faster when you put Bailey Controls at their finger tips.

Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report.

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Bailey Engineers have been making steam plants work efficiently for more than forty years. Veteran engineer and young engineer alike, the men who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

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A138-1

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HELPFUL WATER CONDITIONING DATA FROM BETZ

EMBRITTLEMENT . . .

■ Embrittlement is not a relic of the "horse and buggy days" of steam generation

IN 1957 a 14-year-old, welded, 3-drum water tube boiler required replacement of the steam drum and 295 tubes because of cracks. The cause—*embrittlement.*

In 1957, a 20-year-old, riveted, fire tube boiler was condemned and replaced because of cracks in the shell. The cause —*embrittlement.*

In 1957 a 36-year-old, riveted, 2-drum water tube boiler exploded, killing one man and destroying the entire powerhouse. The cause—*embrittlement.*

These instances are among the most costly and disastrous cases of embrittlement occurring in 1957. Other cases of embrittlement were detected in that year before extensive damage could occur. The year 1957 was not an unusual one for embrittlement except to the plants involved. Most people, today, think of embrittlement as something that happened only in the "horse and buggy days" of steam generation. However, every year another group of boiler operators discover, sometimes in a very costly or disastrous manner, that embrittlement is still ever present.

It is true, of course, that caustic metal embrittlement has declined steadily as a major source of worry for boiler operators for the following reasons:

1. Improved boiler design and fabrication techniques have reduced boiler leakage, one of the conditions leading to embrittlement.
2. The Embrittlement Detector shows an operator when boiler water is embrittling.
3. The proper use of nitrate or coordinated pH-phosphate control effectively inhibits embrittlement.
4. The widespread use of improved methods of water treatment has eliminated, in many cases, the embrittling characteristics of boiler waters.
5. Practically all of the plants which had experienced embrittlement in the past have been using proper protective treatment since embrittlement was first discovered.
6. Some companies (perhaps because of past experience) apply protective treatment to all of their installations, old or new, as a matter of company policy. The cost of the chemicals is cheap insurance against possible loss of life, loss of production and loss of the powerhouse.

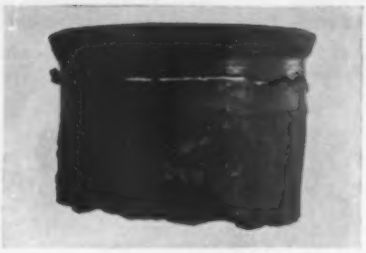

Figure 1—Embrittlement cracks in the rolled end of a tube.

Unfortunately, however, all of these factors tend to reduce our awareness of embrittlement as one of today's problems.

Embrittlement is definitely one of today's problems. Any plant not using protective treatment, or any plant which has changed operating conditions or water supplies since their last Embrittlement Detector test could become a statistic or be liable for a costly repair bill next inspection.

Old age of boilers is no prerequisite for embrittlement. Caustic metal cracking has been found in boilers only *30 days old.* In fact, protective measures should be taken even during the boilout of a new boiler.

The history and theories regarding embrittlement have been thoroughly covered in the past. A brief review of the causes, methods of detection and preventive measures will serve as a reminder.

There are three factors necessary to produce embrittlement of boiler metal:

1. Leakage of boiler water must take place so as to permit escape of steam and concentration of the boiler water at the point of leakage.
2. The boiler metal must be subjected to high stress. This stress may be internal, resulting from cold working of the metal, or the stress may be external, due to expansion or contraction.
3. The concentrated boiler water must possess embrittling characteristics that chemically attack the boiler metal.

Even in boilers with welded drums, inter-crystalline cracking may manifest itself at rolled in tube ends as illustrated in Figure 1.

Figure 2—The disastrous effects of embrittlement.

Detection

If it can be definitely shown that any one of the three factors of leakage, stress or embrittling characteristic of the boiler water is missing, it can then be safely concluded that the danger of embrittlement is non-existent.

The power plant engineer has little control over the factors of leakage and stress. Thus, the factor that best can be shown to be present or absent is the embrittling characteristic of the boiler water.

A chemical analysis of the boiler water will not reveal whether an actual or potential embrittlement problem exists.

The Embrittlement Detector (Figure 3) is the apparatus used to determine if a boiler water is embrittling. A test bar is exposed for 30 days in the Detector, and then check tests are repeated for 60 days and 90 days. If the bar shows cracks during the test, or shows cracks when it

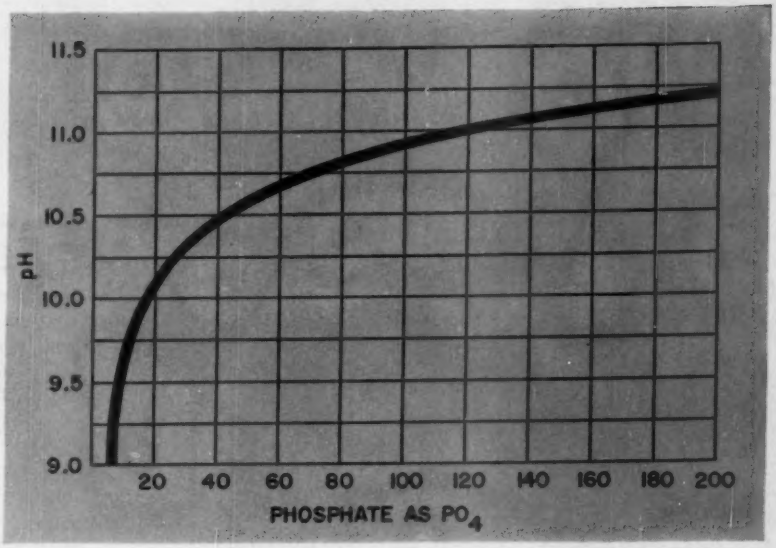

Figure 4—Approximate pH of trisodium phosphate solutions.

THE HIDDEN MENACE

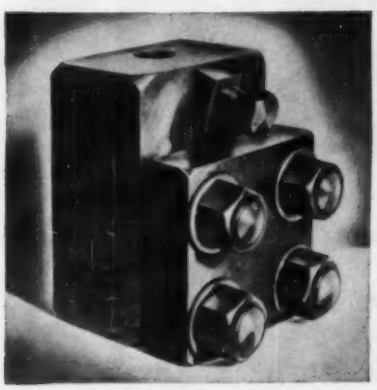

Figure 3—Embrittlement Detector.

is further stressed by the investigating laboratory, the water is embrittling and protective measures should be applied. If no cracking occurs, 90-day confirmatory check tests are run at yearly intervals or when changes are made in operating conditions or water characteristics.

Reliable results can be secured with the Detector providing care is exercised in adjusting the unit during the test. It is also essential that an accurate record of the adjustments be reported to the investigating laboratory so that interpretation of the accuracy of the test run can be determined. In some cases, improper adjustments of the unit have invalidated the test run, necessitating a rerun.

Protective Measures

A report of a cracked bar does not mean it is necessary to abandon the boiler house or seek a new water supply. A far simpler solution is available—the feed of *sodium nitrate*. Sodium nitrate has been inhibiting embrittlement for many years. Practically no cases of embrittlement have occurred nor have they been revealed by the Embrittlement Detector test when sodium nitrate was *properly* applied.

While nitrate is naturally present in many water supplies, the inhibition of embrittlement requires a definite ratio of nitrate to the caustic alkalinity present in the boiler water.

The ratios recommended depend on the operating pressure and are as follows:

	$NaNO_3/NaOH$ ratio
up to 250 psi	0.20
up to 400 psi	0.25
up to 700 psi	0.40

While sodium nitrate has been used in boilers operating as high as 900 psi, the preferred method for preventing caustic metal embrittlement in the high pressure range is the *coordinated pH-phosphate method*. This method depends on avoiding "free" sodium hydroxide (caustic) in the boiler water. Figure 4 illustrates the approximate pH of solutions of trisodium phosphate of various PO_4 content. The PO_4 content and pH of the boiler water are controlled or coordinated to intersect just below the curve. To insure the absence of "free" caustic, a direct analysis of the boiler water for hydroxyl ion should be used in conjunction with the curve.

Failure to take proper precautions against the ever-present but hidden menace of embrittlement will result in possible loss of life or extensive damage to property.

If you would like additional information regarding an embrittlement study made at your plant, we would be happy to have you write us. Why not do it *today?*

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BETZ

■ CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

(at right) 4,000-90,000 lb/hr — The compact Type VP package boiler is available in two basic types and in a wide range of capacities from 4,000 to 90,000 lb/hr. Shipped ready to install on a simple foundation. **Features include:** Pressurized firing, water cooling on all four sides, push-button operation, minimum noise and vibration.

C-E SHOP-ASSEMBLED BOILERS: Type VP — Package boiler for the majority of industrial steam needs; **Type PCC**—Controlled circulation. For high output, high temperatures; **Type HCC** — High-temperature-water boiler. For large-scale heating uses; **Type WCC** — Utilizes waste heat from industrial furnaces. Controlled circulation.

UTILITY-BOILER ENGINEERING GIVES EXTRA DEPENDABILITY

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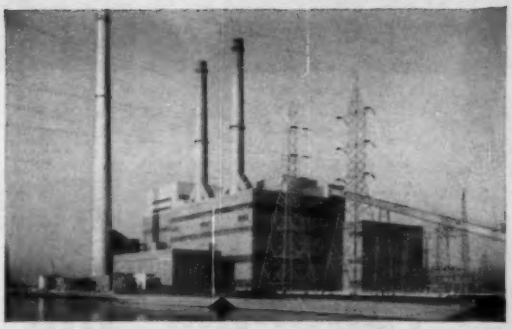
...in C-E Package Boilers

To a large extent, a utility company's operating cost is based on the efficiency and dependability of its steam generating equipment. With a major part of its business being with these power companies, C-E has developed a "utility-boiler" engineering philosophy that applies to *all* C-E products, large or small. You can be sure that *your* C-E boiler represents the latest thinking in thermodynamics and boiler design — and that materials and construction meet the most exacting standards. For *extra dependability*, specify "C-E."

Write to C-E for answers to your questions on C-E package and shop-assembled boilers. Catalogs are currently available on types VP, PCC and HCC.



3,900,000 lb/hr — A good example of utility-boiler engineering . . . C-E is currently at work on a new boiler for Commonwealth Edison Company, Chicago, which is the largest boiler ever ordered by an American utility company. The huge unit will serve a 510,000-kw generator and have a rated capacity of 3,900,000 pounds of steam an hour.

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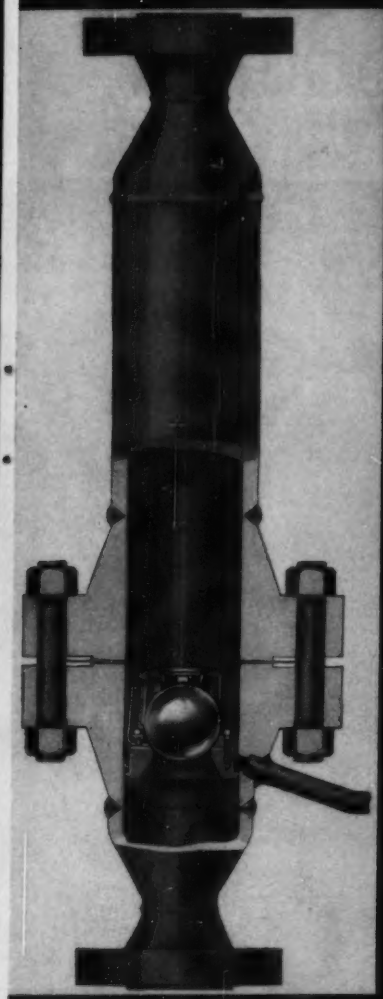
PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

For more data circle 514 on Post Card

H. J. Heinz relies on Copes-Vulcan reducing and desuperheating station to handle big changes in steam demand



(Far left) Chart on left side of panel shows wide load changes. Chart on right indicates exacting pressure and temperature control. Station takes boiler steam at 600 psig and 750 degrees F. and delivers it to process at 110 psig and 360 degrees F.

(Cutaway at left) A weighted steel ball controls orifice opening, speeds intimate mixing of cooling-water and steam. No atomizing steam, spray nozzle, or glands required. Write for Bulletin 1037.

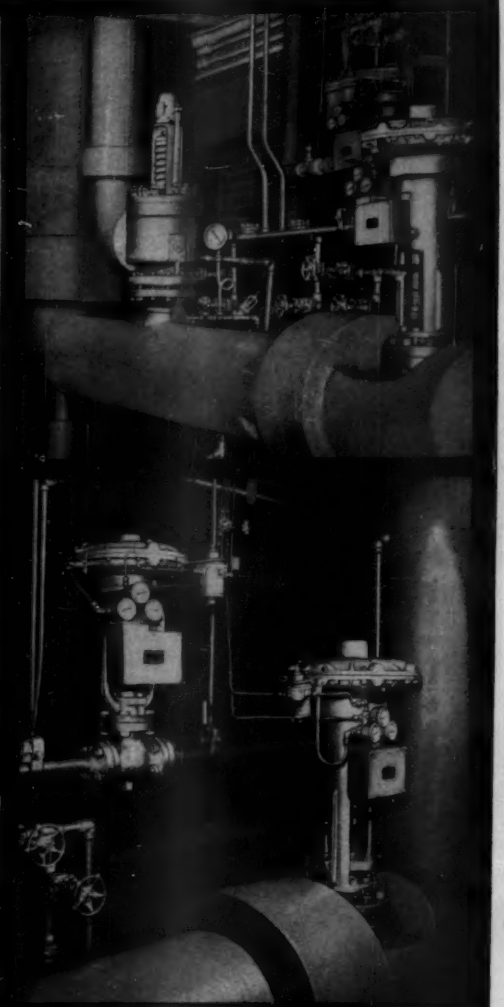
(Upper right) The 8-inch, 300-pound pressure desuperheater is installed in the insulated vertical run of steam piping at the far left. The cooling-water control valve is behind the pressure reducing valve in the right foreground.

Fast acting valves assure rigid control

Cooling water flow for the desuperheater is controlled by a 1-inch, 300-pound standard Type CV-D diaphragm valve (left) actuated by a temperature controller.

The 600-pound standard Type CV-D reducing valve (right) has a 4-inch inlet and 8-inch outlet to take care of steam expansion at reduced pressure. Its positioner assures accurate control modulation.

Copes-Vulcan diaphragm type valves can be direct or reverse acting. Piston types are also available for high duty service, assure maximum power with precise positioning. Write for Bulletin 1027.



Working with flow rates that vary from 0 to 70,000 pounds per hour, this Copes-Vulcan reducing and desuperheating station holds process steam to plus-or-minus 4 psig and plus-or-minus 5 degrees F. with only 16 degrees F. superheat. Wide fluctuations in steam requirements often occur extremely rapidly at the H. J. Heinz plant in Pittsburgh. On a typical day, the load increased from 0 to 47,000 pounds per hour within 15 minutes, then dropped back to 5,000 pounds per hour in even less time.

Made up of a Copes-Vulcan Variable-Orifice desuperheater and diaphragm operated Type CV-D valve, this type of station represents a new approach in process steam control. Since its installation over a year ago, the station has maintained an outstanding record for continuous accuracy.

Whatever your operating conditions, Copes-Vulcan has the desuperheating station for controlling your reduced steam temperatures. Besides the Variable-Orifice type, the line includes a Steam-Assist type and a Carburetor type. Write for details.

Copes-Vulcan Division, Erie 4, Pennsylvania.

Copes-Vulcan Division

BLAW-KNOX

For more data circle 515 on Post Card

The Story of Edward Research

and the Leak-proof Valve

In the early 1940's, the advance of steam power plant pressures and temperatures demanded a leak-proof, small sized valve—one with permanent tightness at the seat joint and one which would solve the failures of mechanical gasketed bonnet joints under elevated temperatures. The story behind the development of the Edward leak-proof Univalve* (sizes to 2½" in 1500, 2500 and 4500 lb. pressure classes) is the story of the product research that solved this industry problem.

EARLY EXPERIMENTING: Elimination of the bonnet joint entirely, by providing a one piece body-yoke construction, appeared to be a logical approach to the bonnet joint problem. But this created a new problem—how to apply and *how to service* an integral Stellited seat from a distant point at the top of the valve yoke. Some valve manufacturers chose to split the valve body near the seat and then reassemble the body with a full pressure weld. Others chose a full pressure weld at the normal bonnet joint position. Neither approach allowed the user to disassemble the valve and both approaches resulted in the sacrifice of a positive, permanent backseat—a desirable feature in any high-pressure valve. Edward engineers refused to make these concessions.

ENGINEERS FIND SOLUTION: After many attempts, Edward engineers developed a water-cooled welding torch for the application of the Stellite seat. This provided a stress-free Stellite layer of uniform density, firmly bonded to the body, free of cracks and pin hole porosity. Simultaneously, other Edward engineers sought the answer to the bonnet joint leakage problem. Extensive research and testing of a variety of body-bonnet combinations and seal-welding techniques resulted in the four elements of today's proven Univalve bonnet joint—a body-bonnet shoulder, load carrying thread, guiding section for alignment and the seal weld.

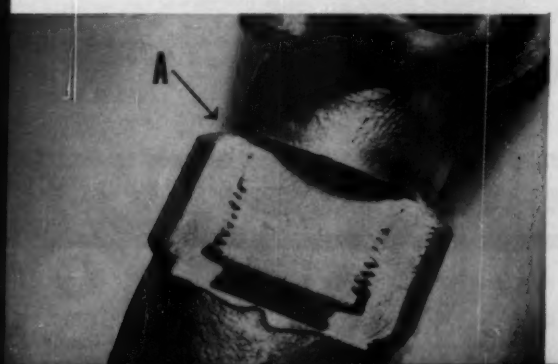
NEW DESIGN PROVES OUT: Months of research testing failed to find a weakness in the new design. Thousands of operations at rated pressure and temperature indicated long-time seat tightness superior to anything previously achieved. Bonnet joint design could not be made to fail at several times the valve rating. Tests were conducted with supercritical steam pressures up to 6000 psi at 1050 F in the only known facilities capable of producing those conditions at that time. And, to date, *hundreds of thousands of Univalves are in service with only one recorded instance of bonnet joint leakage*—a minor defect in the seal weld.

Edward builds a complete line of forged and cast steel valves from ¼" to 18", in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs for pressures up to 10,000 lbs. For more detailed information, contact your Edward Representative, or write Edward Valves, Inc., 1202 West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 438 St. Peter Street, Montreal.

EDWARD STEEL VALVES
another fine product by
ROCKWELL

◀ E. A. STICHA, Chief Research Metallurgist, and R. K. Wagenblast, Research Engineer, measure temperature of valve seal weld in superheater test loop used in Univalve research.

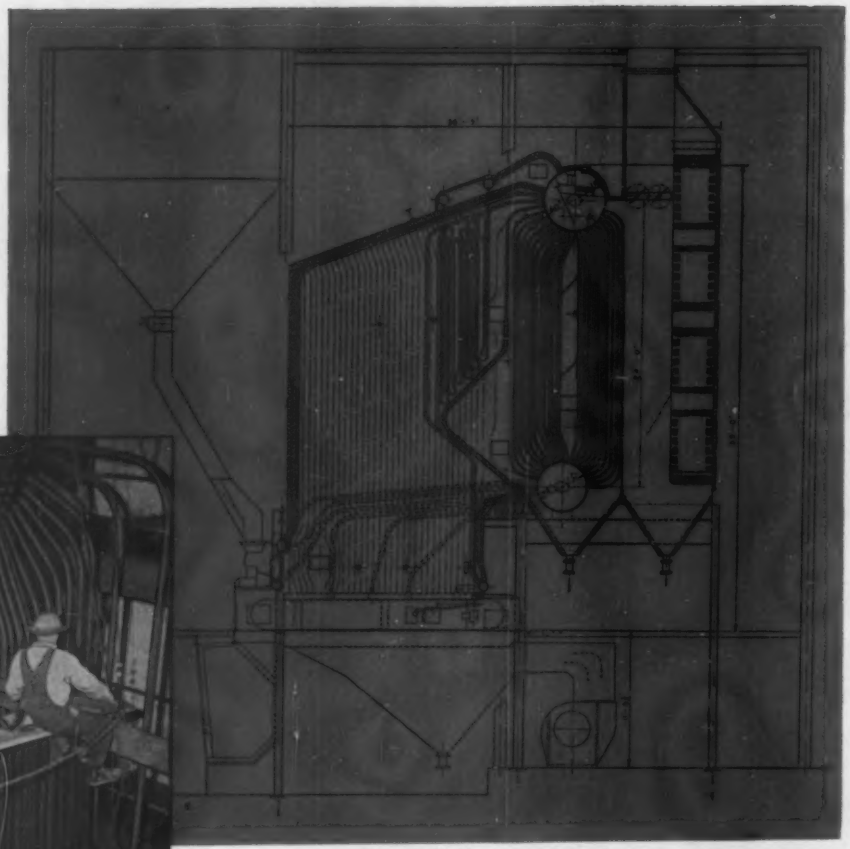
▼ DESTRUCTION TESTS IN EDWARD LABORATORIES IN EARLY 1940's—Bonnet seal weld (A) of test valve cracked only after body creep occurred at 200° F above primary temperature and four times the primary pressure.



CRITICAL LEAKAGE PROBLEMS ATTACKED BY EDWARD RESEARCH ENGINEERS—(A) Bonnet leakage solved by design featuring threaded structural joint and seal weld; (B) Seat leakage solved by revolutionary Stellite seat welding technique.

*T.M. Reg. U.S. Pat. Off.

Union Starch Installs a Modern Coal Fired Steam Generator



Longitudinal section through unit.

Tubes being installed in steam and water drums.

PROJECT BY
ROGERS SCHMIDT
ENGINEERING CO.
ST. LOUIS, MO.

This 125,000 pounds per hour capacity Vogt Steam Generator, especially designed to burn bituminous coal, serves the Granite City, Illinois plant of the Union Starch and Refining Company. The unit operates at 475 lbs. pressure and delivers steam at 750°F. total temperature. It has water cooled front, sides and roof of furnace and employs a spreader type coal stoker.

Vogt offers a complete line of custom built and package type steam generators for power, processing and heating. Bulletins are available upon request.

For Custom Installation Bulletin VF-VS-2 • Package Unit Bulletin PSG-3, address Dept. 24A-BPI.

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P.O. BOX 1918, LOUISVILLE 1, KENTUCKY
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Vogt

STEAM GENERATORS

For more data circle 517 on Post Card

Current Catalogs

Instruments and Controls

101 Electronic Instruments — Illustrated and described in this 12-pp product bulletin are electronic and electromechanical instrument systems of The Liquidometer Corp. Descriptions of products and services are given, with examples of the indicating and control systems designed for industrial and other applications.

102 Industrial Controls — Described in this product bulletin of General Controls Co. are industrial controls for product and process. They include hydrometers, valve operators, electric actuators, automatic control valves, regulating valves, strainers, combustion controls and instruments, process control instruments, time switches, potentiometers, others.

103 Control Equipment, Accessories — Catalog 57-S7, 16-pp, Automatic Switch Co., on accessories and special control equipment, covers breakglass switches, control stations for mechanically held switches and relays, relay panel for gas valve, engine generator isolating switches, transfer switches and phase sequence correctors.

104 Automation Components — A 30-pp reference for automation components and control systems, Condensed Catalog D-31 describes latest timing components and linear measuring systems for industrial use available from Automatic Timing & Controls, Inc. Sections are devoted to electronic timers, special timers and their applications, package control systems, test equipment, controllers, contactors and valves.

105 Computer Talk — This 22-pp glossary of "computerese" — the language of electrical brains — is compiled by Minneapolis-Honeywell Regulator Co. to make computer language more intelligible to the layman. Defines over 82 terms found in the vocabulary of industrial process computer engineers. Minneapolis-Honeywell Regulator Co.

106 Indicating Pneumatic Controllers — Six-pp Bulletin DM058 describes The Bristol Co.'s indicating pneumatic controllers designed for maximum performance and durability. Specifications are included for units controlling pressure, vacuum, liquid level, flow, temperature and humidity.

107 Fluid Flow Rate Alarms — Bulletin 175, Brooks Rotameter Co., contains details on fluid flow rate alarms for signalling or simple control functions manufactured by Brooks Rotameter Co. Specifications are included.

108 On Thermocouples — Minneapolis-Honeywell Regulator Co's., Catalog G100-4 outlines the Megopak line of hard-pack, small-diameter, mineral-insulated thermocouples. Contains specifications, ordering information and prices on bulk material, elements and complete assemblies.

109 Thermocouple Components — Featured in 28-pp Catalog G100-3 are thermocouple components made by Minneapolis-Honeywell Regulator Co., bare elements, elements with insulators, insulators, metal and ceramic protecting tubes, heads, blocks, connectors and miscellaneous fittings. Contains specifications and ordering information on replaceable components for thermocouples.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 113 and 114.

110 Tube Rolling Control — Featured in Bulletin AC-74, The Gustav Wiedeke Co., is an automatic torque control for tube rolling which operates off standard reversible electric drills or tappers, for controlling expansion on tubes ¼-through 4-in. diam. Advantages are noted, accessories described.

Lubrication

111 Gear, Bearing Lubricants — Characteristics and performance of Lubrication Engineers, Inc. gear and bearing lubricants are detailed in this 8-pp bulletin. Describes characteristics of Almasol ingredient and tells how to evaluate various types of lubricants.

112 Industrial Lubricants — Performance of SCL (sulfochloro-lead) industrial lubricants is detailed in 12-pp Lube-Report 102 of The Elco Lubricant Corp. Includes case histories of application in four steel plants as well as information on properties and selection.

113 Extreme-Pressure Lubricant — Properties and applications of Sun Oil Co.'s semifluid extreme-pressure lubricant are detailed in Technical Bulletin 64. Specification data included.

114 Additive Test Data — Lube Report 101, 12-pp, is a technical report by The Elco Lubricant Corp. giving results of tests to evaluate SCL concentrate as a grease additive in comparison with two other additives in which all three were tested in major types of greases. Includes photos showing corrosion comparisons.

Tools and Welding

115 Hand Tools — Illustrated and described in 16-pp Catalog H-9, of Owatonna Tool Co., are a variety of hand tools, including OTC wrenches, pliers, cutters, screw drivers, punches, chisels, sockets, handles, extensions, socket sets, tool sets, tool chests, and other tools. Dimensional data included.

116 Arc Welding — Basic information concerning arc welding techniques for small diameter piping is contained in Lincoln Electric Co.'s, Bulletin 2112.3. Lists advantages of welded piping installations; describes procedures, explaining calculation of welding costs with chart resume of information for schedule 40 pipe 1 in. through 6 in. diameter; and recommends suitable types of electrodes.

117 For Weld Grinding — Catalog 1724, Norton Co., contains 14-pp of detailed information on grinding wheels for every phase of weld grinding. Properties and uses of various types of grinding wheels are covered, photos and selection tables includes.

Pumps and Compressors

119 Centrifugal Pump — Bulletin M60 of The Corley Co., Inc., describes a centrifugal pump with canned stator and flow-through type rotor-impeller. Includes schematic diagram showing liquid flow through rotor and detailed specifications.

120 Progressing Cavity Pump — Characteristics and operation of the Moyno progressing cavity pump are detailed by Robbins & Myers, Inc., in 20-pp Bulletin 100. Includes engineering data and selection tables, product photos, dimension drawings and specifications.

121 Submersible Pump — Illustrated and described in this 10-pp bulletin are applications for submersible pumps manufactured by Kenco Pump Div., The American Crucible Products Co. Lists physical dimensions, pumping capacities, electrical data and detailed specifications.

122 Pipeline Compressors — Mechanical and hydraulic design considerations for two-stage centrifugal pipeline compressors are detailed in 10-pp Bulletin 187, furnished by Clark Bros. Co. Charts, diagrams and important calculating formulae are given.

Boilers, Heat Exchangers

123 Waste Heat Boilers — Bulletin 1700 describes International Boiler Works Co.'s forced recirculation generators designed for maximum use of waste heat from industrial and process heat sources. Contains engineering drawings and data.

124 Low Pressure Heat Exchangers — Eight-pp Bulletin 110, of Brown Fintube Co., describes low pressure double pipe heat exchangers. Salient features of design are discussed, including one-piece fintube, and data on thermal and mechanical efficiency, materials of construction, and specifications included.

Valves, Traps, Piping and Fittings

125 Discharge Valves — Featured in 16-pp Bulletin O2B9206 released by Allis-Chalmers Mfg. Co. are valves designed to provide efficient regulation and control of water under free discharge. Application sketches and data are included, as well as specifications.

126 Butterfly Valves — Illustrated and described in Catalog 307 released by Mason-Nelian Div., Worthington Corp., are butterfly valves for control of large volumes of liquids or gases. Shows typical variations of light and heavy duty wafer style valves and describes three basic body designs — swing-through, angle seating or soft seat.

127 Midget Solenoid Valve — Described in Folder 2142-3 are Hays Mfg.

Co.'s Midg-O-Matic Valves for small flow applications in equipment where space is limited. Detailed specifications are included, as well as flow capacity chart and solenoid electrical data.

128 Electrically Operated Valves — Described in 20-pp Bulletin 91024, Air-matic Valve, Inc., are two-way, three-way and four-way electrically operated valves. Includes descriptions, specifications, flow charts, ordering and dimensional data.

129 Bronze Gate Valve — Sectional views detail the features of a union bonnet bronze gate valve in Lunkenheimer Co.'s, Circular 610. Also included is a table of dimensions. Available in sizes ¼- to 2-in., this valve has a double wedge disc, rising stem, is rated 125 lb sp, 200 wog.

130 Thermostatic Radiator Traps — Construction and operation features of thermostatic radiator traps and float and thermostatic traps manufactured by Sterling, Inc. are described in Bulletin 102. Includes diagrams, roughing-in dimensions and capacity tables.

131 Steam Traps — Eight-pp Catalog FE-310 provides information on Farris Engineering Corp's. low-cost bi-metal thermostatic and float thermostatic steam traps. Describes advantages and operation and includes complete specifications.

132 Ductile Iron Pipe — Properties and specifications of ductile iron pipe and fittings are detailed by James B. Clow & Sons, Inc. in this 20-pp bulletin. Table of comparative resistance in some corrosive media included along with other data and illustrative material.

133 Hose Fittings — Low-pressure, reusable hose fittings and rayon braid hose are featured in this 12-pp product bulletin of The Lenz Co. Contains data on reusable hose couplings, union swivel adapters, hose assemblies in one and two rayon braid with reusable couplings, oxygen and acetylene couplings and connectors, paint spray air hose couplings and connections, male and female hose stems, joiners.

134 Pipeline Strainers — Four basic types of pipeline strainers for condensate, steam, water, oil, air, gas and other piped fluids are covered in Sarco Co., Inc. Bulletin 1210. Construction and operating features of a range of strainers designed to protect steam traps, pumps, control valves, compressors and other equipment against dirt, scale or metal chips in pipelines are fully detailed.

135 Hose Clamps — Sixteen-pp Booklet 5-60 by Wittek Mfg. Co. contains illustrated information on standard clamps used in a variety of industrial and other applications for hose, flexible plastic pipe and duct connections.

Water Conditioning

137 Mixed-Bed Deionizers — Bulletin 512A and its accompanying technical data sheet describes Elgin Softener Corp. deionizers of mixed-bed design, containing a mixture of cation and anion resins in a single tank. Advantages and applications are detailed.

138 Industrial Water Service — The importance of water to industry and advantages of an industrial water consulting service are detailed by Hall Laboratories in this 22-pp bulletin. Specific examples of benefits offered typical users of the consulting system are given.

139 Corrosion Inhibitor — Bulletin CSP-935 describes a corrosion inhibiting compound developed by Calgon Co., (Div., Hagan Chemicals & Controls, Inc.) for treatment of recirculating cooling water systems. Performance data in corrosion control, elimination of sludge deposition, concentration of make-up water detailed.

140 Cooling Tower Maintenance — "How To Extend Cooling Tower Life" is the subject of a water conditioning data sheet offered by Betz Laboratories, Inc. Discusses how deterioration of cooling tower wood by chemical, biological and physical factors shortens life of cooling towers. Betz Laboratories, Inc.

Electrical Equipment

141 On Electric Motor Design — Twelve-pp Bulletin PB 6000-10, Elliott Co., develops the premise that electric motor design consists of a series of concentric circles. Large close-up photos illustrate step-by-step manufacturing process, each supporting the premise that good motor design depends on concentricity.

142 Packaged Substations — Compact, packaged electrical substations which can be located right at the load areas are featured in 8-pp Bulletin 5601-1A of I-T-E Circuit Breaker Co. Component details are illustrated and described, with sketches, photos, and selection data.

143 Lighter, Stronger Transformers — Eight-pp Bulletin GEA-6832A, General Electric Co., describes distribution equipment transformers, redesigned to be mechanically stronger and 14 per cent lighter than previous models. Tables and diagrams give electrical and mechanical characteristics.

144 Load Center Selector — Booklet GED-3625 is a 48-pp shirt-pocket-size catalog on General Electric Co.'s Twin circuit breaker load centers and meter socket-load centers. Contains wiring diagrams and listing of ratings, circuit capacities and other ordering data. Also covers installation and quality features and describes company's new 70- and 100-amp plug-in breakers which reduce material costs by eliminating need for separate main diconnect enclosure.

145 D-C Contactors, Relays — Illustrated and described in 32-pp Bulletin GEA-6621A of General Electric Co. are contactors and relays for all d-c industrial control. Discusses "building block" approach and includes illustrations, layout and schematic diagrams, application data and specifications.

146 Vertical Break Switch — Featured in this product bulletin of Delta-Star Electric Div., H. K. Porter Co., Inc. is a high voltage vertical-break air switch with simplified linkless, leverless and braidless design. Large photo with keyed numbers points out blade mechanism, high pressure contacts and other details.

147 For Switchgear Protection — Eight-pp Bulletin 6020 describes the Fusematic concept in switchgear protection, based on an integral combination of a power circuit breaker and current-limiting fuse designed by Federal Pacific Electric Co. Applications are detailed, along with parts and technical data, and time-current characteristics graph included.

148 Commutating Switch — Described in this product bulletin of American-Standard is a high speed commutating switch in which a jet of mercury replaces the conventional wiper arm. Applications in data sampling, precision function generation, analog multiplication and high power pulse generation detailed.

149 Line Tap-Off Switches — Economies in installation and operation of line tap-off switches are described in I-T-E Circuit Breaker Co.'s Bulletin 1130-A, 12 pp. Illustrates switches for one-, two- or three-way switching arrangements, and includes photos, sectional diagrams and vertical mounting dimensions.

150 Hook-Operated Switch — Featured in 12-pp Bulletin 1030A is a low cost, full performance, all-purpose hook-operated switch offered by I-T-E Circuit Breaker Co. Describes design and construction features, advantages, and includes dimensional and ordering data.

151 Low-Impedance Bus Duct — Application data for low-impedance bus duct is contained in Westinghouse Electric Corp.'s 20-pp Application Data 30-662. Descriptions, drawings, dimensions, specifications, and engineering data give specific information needed to install this type of bus duct.

152 Stationary Batteries — Features and advantages of Gould Plante batteries for use in switchgear, alarm systems, telephone, control, signalling or emergency light and power applications are detailed in 12-pp Bulletin GB 1783-B, released by Gould-National Batteries, Inc. Engineering specifications, graphs of discharge characteristics, dimensional data, and illustrations are included.

153 Thermocouple Wire — Twelve pp of information on thermocouple wire and extension wire, bare and insulated, make up Minneapolis-Honeywell Regulator Co.'s Catalog G-100-2. Thermocouple wire selection data included.

Vibration Control

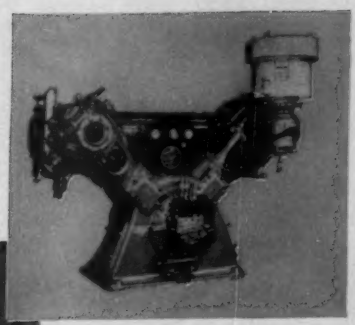
154 Machinery Mountings — Steel spring machinery mounting for vibration, shock and noise control is featured in 6-pp Bulletin K3C released by The Korfund Co., Inc. Lists variations available and includes table of capacity and characteristics and other data.

155 Resilient Mountings — Eight-pp Bulletin 905, offered by Lord Mfg. Co. is an illustrated guide to resilient mountings and mounting systems for vibration, shock and noise control. Includes general design, application and performance data.

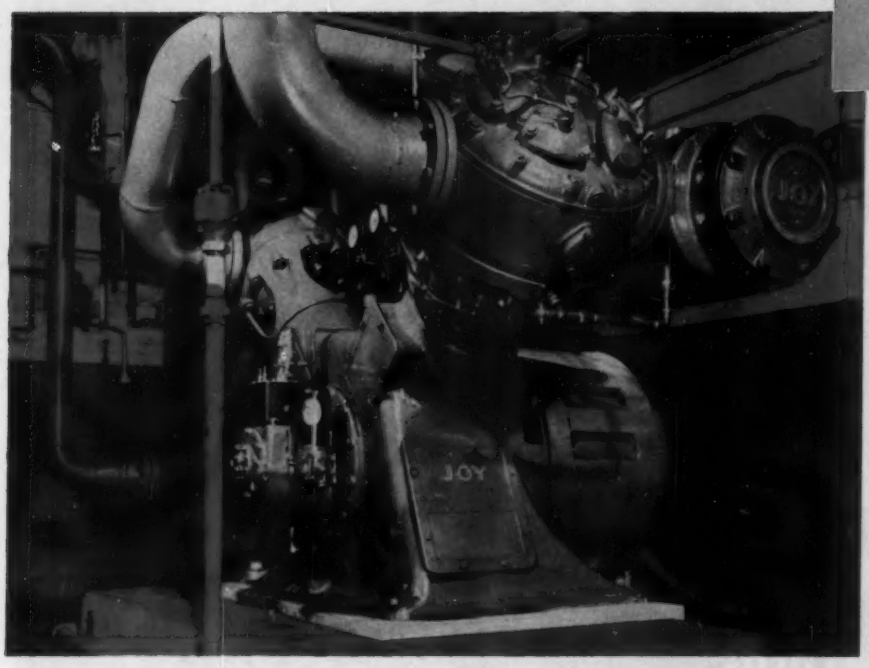
Fans, Ventilating and Air Conditioning

156 Airfoil Bladed Fans — Features and advantages of the American-Standard centrifugal type airfoil bladed fans are detailed in 60-pp Bulletin A-1103. Includes cutaway illustrations showing wheel construction and two types of blade construction, as well as an illustrated discussion of modifications, data on methods of volume control, and 30 pp of capacity tables for standard air conditions.

more Current Catalogs page 113



Compact design means simple installation. Set up on a simple block foundation, bolt down and connect air and water lines.



the COMPACT compressor with big compressor features...Joy WN-112

Only the package designed WN-112 has such heavy-duty features as replaceable cylinder liners and crosshead guides. These liners are made of special alloys which make possible fine machining and mirror-like polishing. The crosshead has no wedges, set screws or shims—never requires adjustment. The main bearings never need adjustment either because they are anti-friction, heavy duty ball, or spherical roller type. These, and other big compressor features add up to trouble-free performance that has made friends of literally thousands of plant and power engineers throughout industry.

When you are expanding your operations and require more compressed air, make sure you have details and complete information on the WN-112, one of a complete line of compressors for industry. You can then select any one of 24 standard models of the WN-112 plus special models for high and low pressures as well as oil-free operation. Capacities from 480 to 1072 cfm. Write for bulletin 340-56C.

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Detroit Stokers satisfy industrial, institutional and heating needs on every continent of the earth.

Why this universal preference? One important reason. They are engineered for high efficiency, reliability and long life.

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Also special designs for municipal and industrial incinerators.

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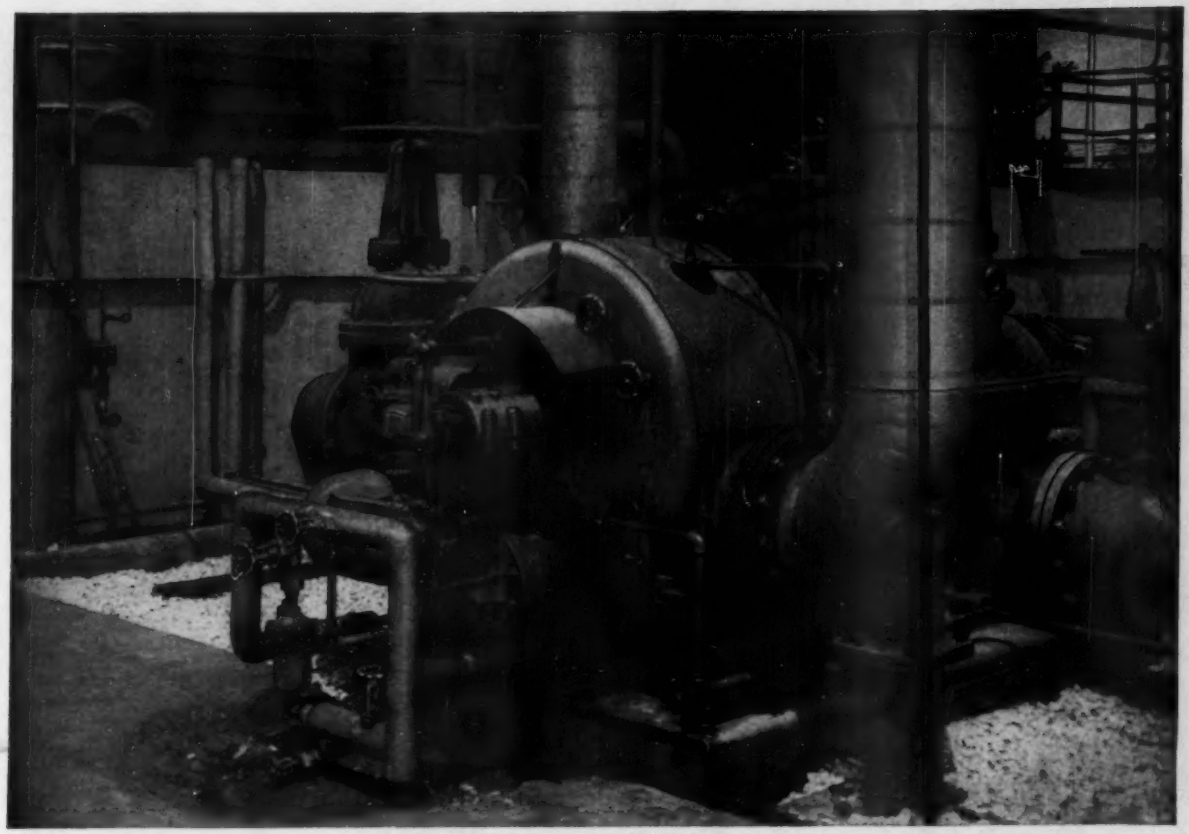
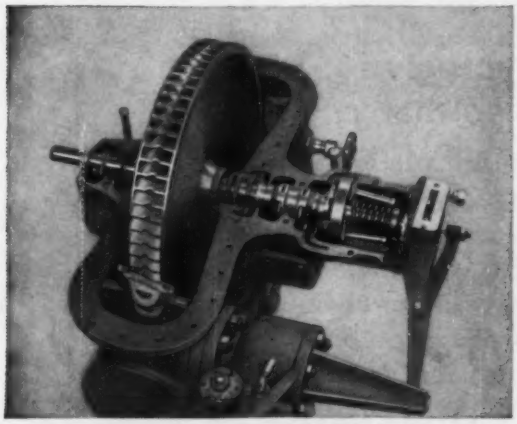


TERRY SOLID-WHEEL TURBINES

used exclusively at Baton Rouge plant of W.R.Grace & Co.



The upper photograph shows one of the 17 Terry turbines installed at the Baton Rouge, La., GREX high-density polyethylene plant of W. R. Grace & Co. Above, a typical Terry solid-wheel turbine with cover removed to show the wheel construction.

In purchasing equipment for their new 50,000,000-pound high-density polyethylene plant, W. R. Grace & Co. standardized, wherever possible, on a single source of supply for each type of equipment used. Consistent with this policy, Terry steam turbines were used exclusively throughout the utility and process sections of the plant.

A total of 17 turbines were placed in service for driving pumps and fans. These are all of the solid-wheel type, ranging in capacity from 50 to 240 HP.

Terry solid-wheel turbines are known for their long life and sure dependability under the most-trying operating conditions. They feature a single-piece wheel which is virtually indestructible.

Send for details of these trouble-free turbines. Ask for a copy of bulletin S-116.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1214

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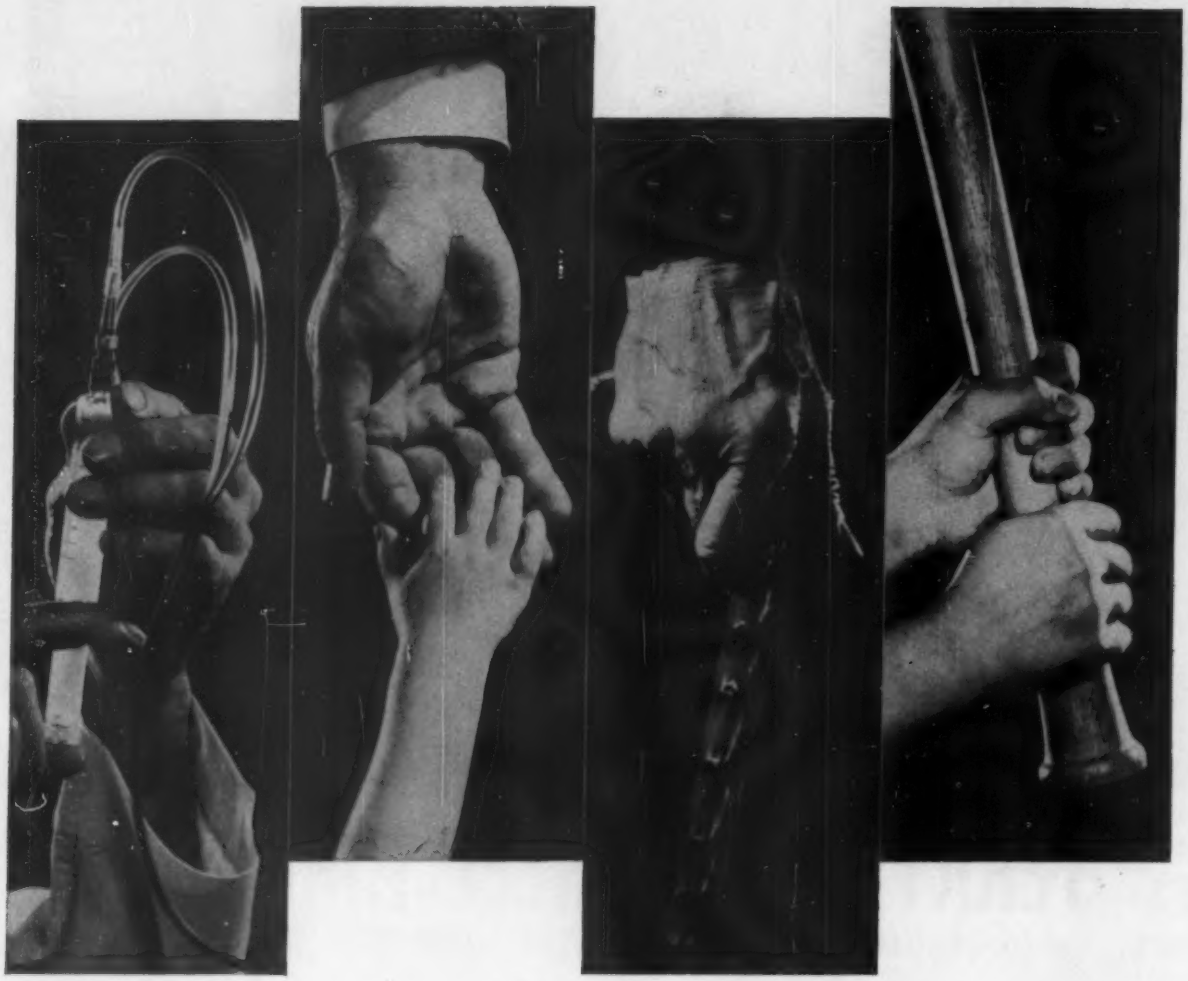

With one pledge you give a helping hand to so many

When you make your one big pledge to your town's united campaign, you are actually giving to many campaigns in one. Your contribution fights disaster and disease, works to prevent juvenile delinquency, and attacks the problems of the aging and the breakdown of family life. United Way pledges support 27,700 local, state, and national agencies which serve 77,400,00 Americans. When a United Way Volunteer asks you to give, welcome him with your pledge.

GIVE THE UNITED WAY

*Controls for a 1,260,000 lb/hr boiler are housed on a 36" wide console**

Centralized control space-saver

... the POWRMAG REMOTE CONTROL STATION

Easy to operate, and featuring front mounting and removal, the PowrMag Remote Control Station is ideal for the compact consoles demanded by centralized control. Here are some of the facts on PowrMag:

FULL STATION—size 2¼" x 5¼". As shown above, contains set point, bias or ratio dial, manual/automatic switch, manual control dial, output signal and null indicators.

HALF STATION—size 2¼" x 3¼". With set point, bias or ratio dial, plus output signal indicator.

BUMPLESS TRANSFER—Simple adjustment of null-indicator provides bumpless transfer from Manual to Automatic or back. No operator memory is required. Output signal indicator shows valve or other control element position.

FRONT MOUNTING AND REMOVAL—Makes unit easy to check or change. AN-type connector, and 12-wire color coded cable makes it easy to interconnect system.

The complete system includes PowrMag Control Units and PowrMag Patchboards. Control units consist of operational magnetic amplifiers together with interchangeable reset, rate and other circuit packages to perform all control functions. Patchboards interconnect the system in any desired manner—no solder connections or terminal boards—all connections are made by special taper pins.

A letter or phone call will bring you more information on reliable, space-saving PowrMag. **Ask for Bulletin MSP-163.**

*Name on request

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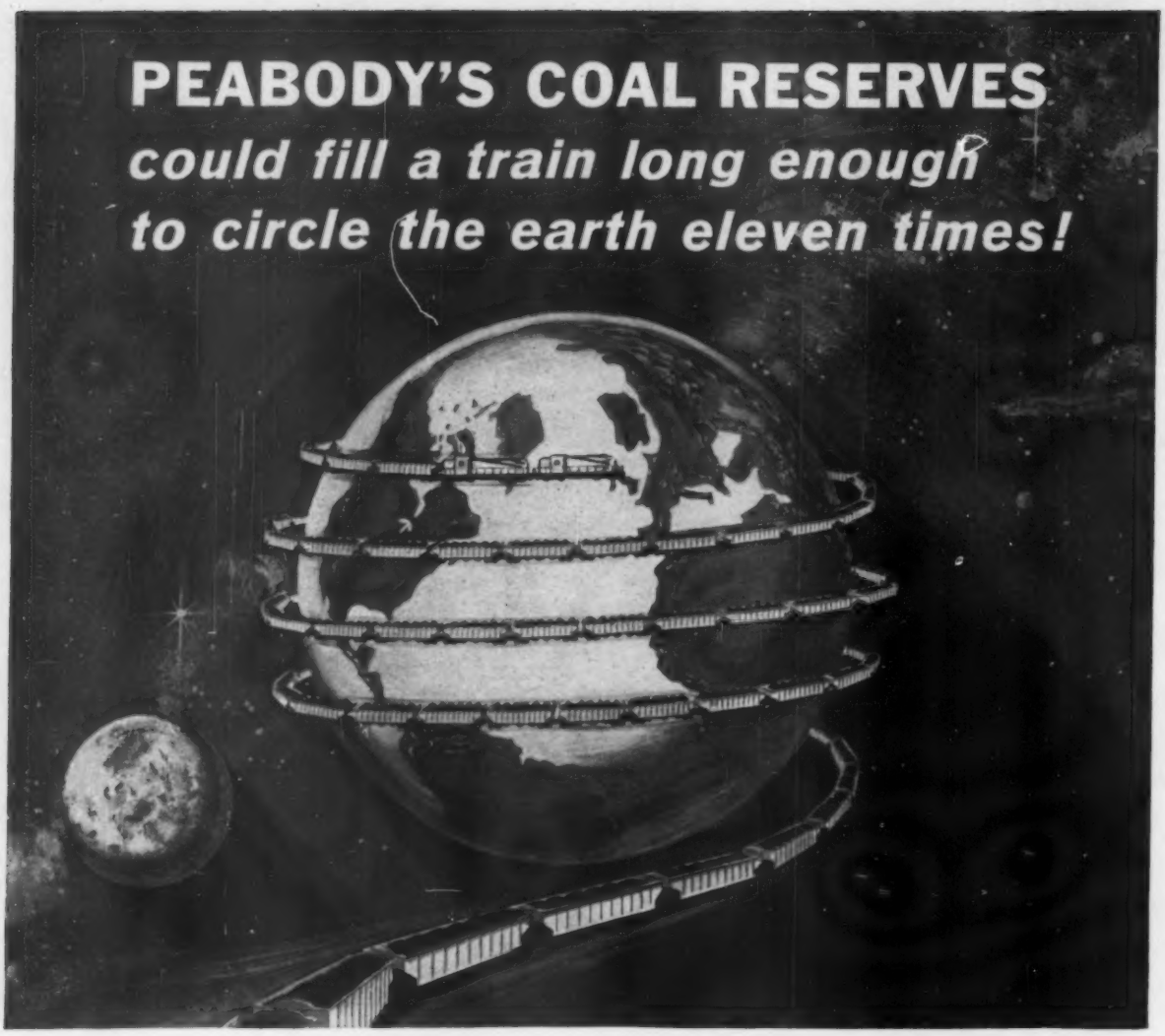
PEABODY'S COAL RESERVES

could fill a train long enough to circle the earth eleven times!



This Tremendous Coal Reserve... Over Two Billion Tons ... Is Your Assurance of a Dependable Source of Fuel

Imagine a train 200,000 miles long . . . over 38,000,000 hopper cars filled with coal . . . that's a lot of fuel! In terms of potential power, Peabody's coal reserves could light and power Chicago for 200 years. These vast reserves . . . strategically located near the nation's inland waterways—plus Peabody's efficient mining facilities . . . are your assurance of an economical supply of coal for years to come. And at Peabody's modern, automated Processing Plants, coal is tailor-made to get maximum efficiency from your burning equipment.

Whether you buy a carload or a trainload . . . your business is important to Peabody. Plan now to use this vast fuel reservoir. Call your nearest Peabody Office *today.*

Learn more facts about Peabody Coal . . . its importance to the nation's economy and your business. Send for Peabody's new FREE booklet, "COAL . . . ANCIENT STOREHOUSE OF MODERN LIVING."

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NALCO'S OWN POPULATION BOOM...

(in Water Treatment Skills and Experience)

These are the Nalco people in the background* when a Nalco Representative tackles your water treatment problem. He can call on any or all of them when necessary ... and the specialized skills and experience they have are strong support for his own expert knowledge of water treatment chemicals—and how plants should use them.

Nalco's population boom in water treatment skills and experience is simply further assurance that when you want water treatment *results* your Nalco Representative is the man to call.

**The technically trained headquarters people who conduct research and customer service work on every kind of water treatment problem.*

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AMERICAN BI-METAL THERMOMETERS make accurate temperature readings sharp and sure at all check points

American Dial Thermometers are also available in mercury, vapor pressure, and gas actuation . . . on-the-spot and distant reading types . . . in sizes, ranges and stem lengths to meet your most exacting requirements.

sensitive

Any way you look at an American Bi-Metal Thermometer, you see exact working temperatures.

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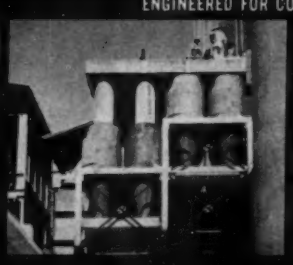

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A. W. Kramer, Editor

A Periodic Report on Atomic Energy Development Throughout the World
Published by Technical Publishing Co.

September 1960

The Radioactivity Around Us. The growth of atomic energy has been accompanied by an understandably widespread concern over the hazards of atomic radiation. The dangers inherent in the fall-out from atomic bomb explosions were, of course, obvious from the beginning, but fears have also been expressed concerning the effects of the peaceful applications of atomic energy. There are fears that the continued construction of nuclear power plants and the use of nuclear energy for propelling ships may harm man's health and heredity to an extent that is incalculable at the present stage, and nothing is of more portent than the dread of the unknown.

Although much is still unknown, enough is already known to indicate that the hazards involved in the peaceful pursuit of the atom are not as great as some workers in the field have claimed. The nature of the possible dangers is essentially clear, and if their extent and what may be termed their modes of operation and specific effects are still matters of some expert disagreement and much popular conjecture, one can assert that the hazards are not such as cannot be controlled.

That the hazards exist is not denied; nor is it claimed that they can be eliminated altogether. All nuclear fuel is radioactive, and the use of such fuel in nuclear reactors creates tremendous quantities of new radioactive material. And since ionizing radiation is potentially dangerous, the production of these new radioactive substances (fission products) increases the sources of radiation to which people may be exposed, and consequently the harm that may be caused.

No human ingenuity can wipe out this radiation. It cannot be neutralized as in the case of chemical poisons. Nothing that humans can do can change the rate at which radiation is produced. As is well known, the atoms of all radioactive isotopes disintegrate with the emission of nuclear radiations in such a manner that half the atoms of any given amount of the substance disintegrate in a particular time which is immutably fixed for every radioisotope but varies from one isotope to another.

What human skill and organization can do, however, is to eliminate as far as possible the chances of exposure to radiation and hence the possibility of harm. We can be reasonably certain that the employment of atomic energy to promote man's peaceful progress need not be attended by an impairment of his health or genetic future. Experience has shown that it is possible to devise and adopt adequate measures of safety. As an example of how radiation hazards may be reduced, radiation exposure records for General Electric Co employees at the Hanford Atomic Products Operation show that not one atomic worker has received as much as one-third of the maximum permissible accumulated dose of penetrating radiation. Analysis of the health records showed that more than two-thirds of the 7803 people employed by General Electric at Hanford at the end of 1959 had accumulated external penetrating radiation doses totaling less than one per cent of the maximum permissible dose recommended by the National Committee on Radiation Protection

and Measurement. More than 90 per cent of the Hanford workers had accumulated radiation doses amounting to less than ten per cent of the recommended maximum permissible dose.

The General Electric record shows what can be done. The task confronting us is to attain a similar safety record in atomic operations throughout the entire world. The task has two broad aspects: to ensure that people engaged in atomic energy activities are not exposed to excessive radiation in the course of their work, and to protect the world's population in general from the radiations given off by the radioactive materials produced by the atomic energy industry. The first requirement has to be met by the adoption of protective measures in all atomic energy establishments and laboratories where radioactive materials are used. As indicated by General Electric's record, this can be done.

More important, at least from the public point of view, is the work to ensure the safety of people in general. The basic aim in this respect is to see that the development of atomic energy applications does not lead to an increase in the levels of radiation in man's immediate environment.

Our Natural Background. It must not be forgotten that all of us are inescapably subjected to some amount of radiation from our natural background, from the radiation from radioactive elements in the earth's surface (e.g. uranium and thorium and their daughter products), cosmic rays, and substances like radiopotassium and radiocarbon present in our bodies. Man has always lived with this radiation, and although its effects may not have been favorable, at least he has been able to survive.

Release of new radioactive material in the environment as a result of the peaceful applications of atomic energy would certainly add to this background radiation, and it is generally believed that a substantial increase in the levels of general radiation may upset the delicate balance between man and his environment. The precise extent of the increase that is likely to be harmful may still be debatable, but the aim must be to keep it well below the threshold of danger.

The main effort in the achievement of this aim must be directed towards preventing the newly created radioactive material from getting into man's environment and increasing the levels of radiation. Essentially, this is a problem of the safe disposal of radioactive wastes (ATOMICS, Nov, 1959).

This is a problem in which the International Atomic Energy Agency (IAEA) in Vienna is vitally concerned. The Agency has done considerable work in formulating measures for safety in atomic energy establishments and also in determining the safe limits of the disposal of radioactive wastes. Aspects of these problems were discussed in detail at a conference in Monaco last November, and the exchange of ideas and information that took place there is being followed up with intensive research on methods of disposal that are both adequate and safe.

Environmental Radioactive Contamination. Despite all safety measures, however, a certain amount of radioactive material is likely to be released to our environment. That, itself, need not be a cause for concern because if the precautions are adequate, the nature and amount of the radioactive material that will be added to the environment as a result of peaceful atomic energy will not be such as to constitute any significant health hazard. A test of the adequacy of safety measures, therefore, is the extent of the radioactive contamination of man's environment. If the amount of man-made radioactivity in the environment is large enough to pose any threat to man's health or heredity, appropriate measures must be taken to reduce the extent of contamination and keep it within safe limits.

The IAEA's Role in Environmental Considerations. An important task, therefore, is to keep a continuous watch on the levels of environmental radioactivity, and this is a task in which the IAEA has a special interest, since the Agency represents the world point of view. Several Member Governments have expressed concern over this problem and have asked the Agency how it could assist them in the measure-

ment of radioactivity in the biosphere; i.e., air, water, soil, and food. The problem has also engaged the attention of the United Nations, particularly of its Scientific Committee on the Effects of Atomic Radiation. The General Assembly of the United Nations, after considering a report of the Committee last November, unanimously adopted a resolution calling for the widest possible coöperation in establishing a program of research and analysis in this connection. The resolution contained several references to the IAEA's possible contribution to this program and to possible coöperation between the IAEA and the Radiation Committee.

The Radiation Committee is concerned with the entire problem of radioactive contamination, a large part of which is due to radioactive fall-out as a result of the nuclear weapons tests. The IAEA is concerned specifically with the peaceful applications of nuclear energy and the radiation hazards involved in these applications. It would, however, be obvious that in studying the problem of environmental radioactivity it is hardly possible, in most cases, to isolate the effects of the peaceful uses from those of the military applications. There is no means of determining with absolute certainty whether the presence of some radioactive material in a particular sample is due to fall-out or to the release of radioactive waste from a nuclear installation. But whatever the source of contamination, the measurements of environmental radioactivity and their evaluation would be of supreme importance in ensuring human safety in the atomic age.

Considerable work has already been done or initiated, but most of it has been undertaken specifically in connection with fall-out problems or occupational health hazards in nuclear installations and surrounding areas. The hazards that may affect whole populations as a result of release of radioactive waste from reactors or from fuel-processing installations deserve equally close attention and may, in fact, call for somewhat different methods for sample collection and analysis to determine trace amounts of radioactive substances in the biosphere.

Complex Problem. The determination of the maximum permissible concentration of radioactivity in the various divisions of the environment is a rather complex problem because it involves not only detailed knowledge of the various isotopes that may be released but also of how such isotopes may enter into biological cycles. In the case of the disposal of radioactive wastes in ocean waters for example, it is very important to have accurate data on the flow of water in confined harbors and estuaries, and this involves studies of tidal cycles. Such inland waters are often the source of marine foods such as clams, oysters, and certain seaweeds. Such marine organisms often concentrate on certain elements to a very high degree, and if these elements happen to be radioactive, the concentration of radioactivity in such marine life may be thousands of times greater than that of the water in which it develops. The continental shelf also provides the environment for commercial fishing grounds, so it is essential that the disposal of radioactive wastes into this portion of the marine environments be regulated very carefully. This question of the absorption of radioactive elements by marine life has been under careful study by the National Academy of Sciences and the National Research Council in this country, and it has also been the subject of serious discussion by foreign regulatory bodies.

Experts' Recommendations. The importance of the subject was clearly recognized by an international panel of experts convened by the IAEA last September. This panel, which was composed of prominent experts from Argentina, Australia, Canada, France, Germany, Japan, Sweden, the United Kingdom, and the United States, unanimously recommended that the IAEA should set up adequate facilities for the collection and analysis of samples to determine the extent of environmental contamination due to the peaceful uses of atomic energy. Moreover, the panel recommended that the facilities should be available not only for the measurement of samples submitted by Member States but also for the training of scientists and technicians in order to enable them to set up and operate similar facilities in their own countries. The panel made definite recommendations on the types of operations which the IAEA should carry out. It also suggested that the Agency should undertake the development, construction, and operation of equipment for measuring the levels of contamination to be expected after any accidental and potentially hazardous release of radioactive substance in the course of peaceful atomic energy work, and that

such equipment and the associated staff should be made available to Member States in the event of any nuclear accident.

Measurement Requirements. The members of the Panel pointed out that any system that the Agency might establish for the measurement of radioactivity should be able to meet two basic requirements. First, it should be able to detect sudden releases of radioactive material quickly enough to enable the adoption of appropriate countermeasures if possible, and second, it should be able to keep a continuous watch on the levels of hazardous radioisotopes in the biosphere built up by small periodic releases. In case of accidental releases, the measurements must be carried out in those parts of the biosphere which are likely to be immediately contaminated; namely, air and surface water. For routine measurements of radiation levels, an important field of investigation would be the food chain, which is one of the main channels of contamination of the human body. This aspect of the problem, as already pointed out, is of great importance in the disposal of radioactive wastes in ocean waters. Again, analysis of soil samples would be useful in indicating the accumulated contamination at any particular time.

The panel emphasized the importance of establishing standard procedures for sampling, analysis, and measurement. In the case of samples containing extremely small amounts of radioactive substances, special precautions would be necessary in regard to the location of the laboratory as well as the measurement procedures. For example, measurements of samples with low levels of radioactivity should be made at places which are away from obvious radiation sources.

The recommendations of the Panel have been carefully examined by the Agency in the light of its scientific resources and its statutory functions. The urgency of the tasks envisaged by the panel and the Agency's role in fulfilling them have been widely recognized. Apart from inquiries from the Agency's Member States, the United Nations General Assembly resolution, mentioned earlier, specifically invited the IAEA and the World Health Organization to consider and inform the Radiation Committee of what assistance they might give in connection with the analysis of samples.

It is against this background that the IAEA is going to engage itself with a program for the study of environmental radioactivity. One of the principal objectives of this program in the initial stages is to establish standard methods of sampling, analysis, and measurement. The methods employed at present are not uniform, and the need for universally accepted standards is particularly important in this work, both for equipment and the techniques used. The IAEA's laboratory, now being built at Seibersdorf near Vienna, will be specifically equipped for standardization work, such as the calibration of monitoring and dosimetry equipment and the establishment of international standards in measurement techniques.

Andrew W. Kramer

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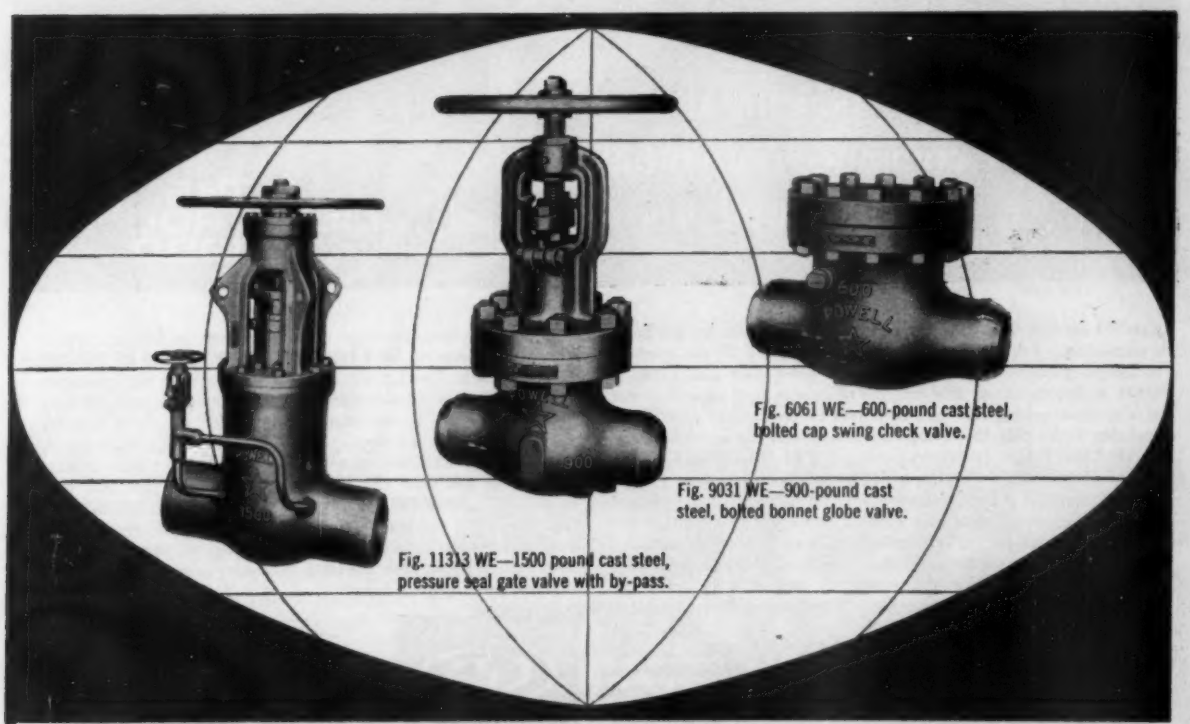

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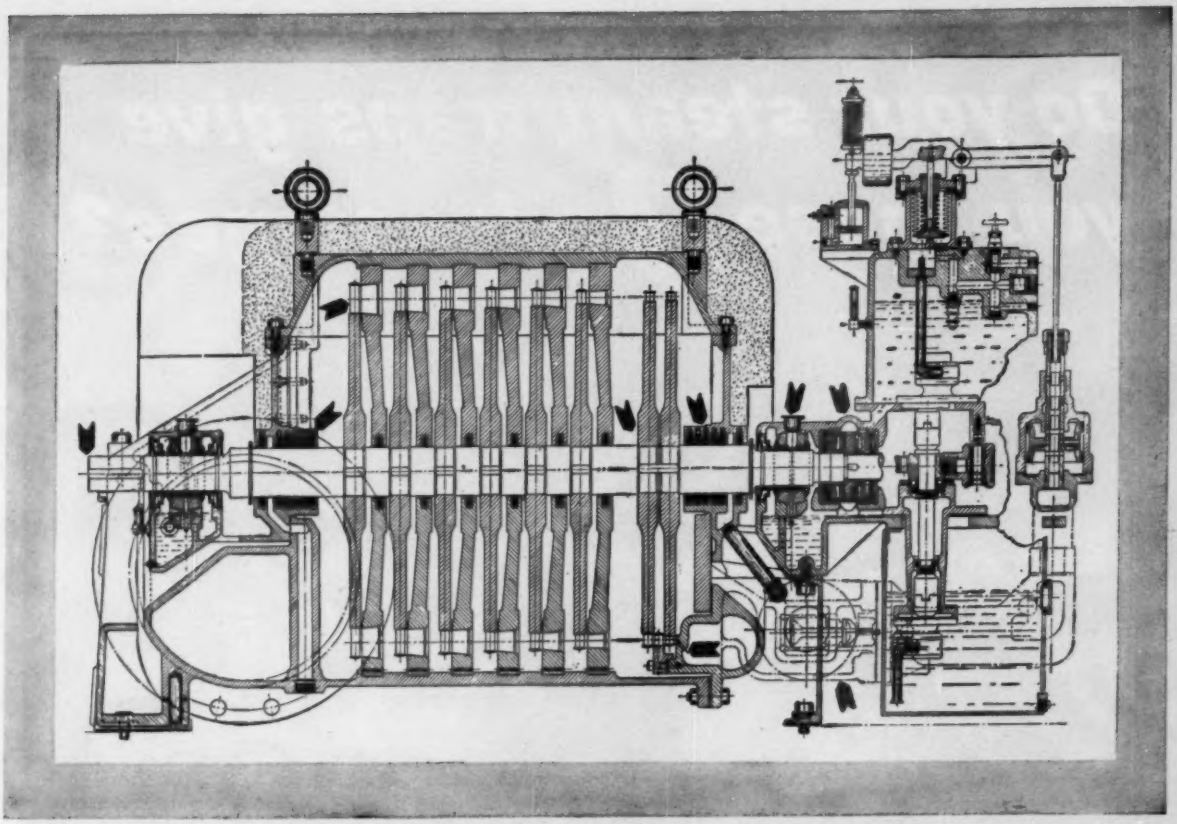

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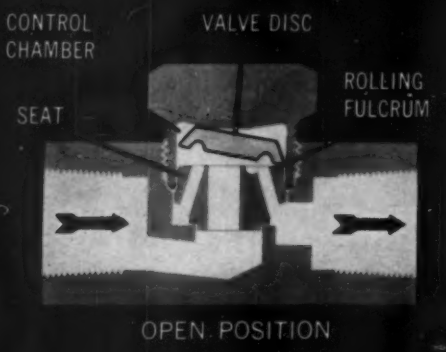

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From all over the world, power engineers met in Paris, France to discuss high-voltage electrical developments — at the Conference Internationale des Grand Reseaux Electriques, better known, by its initials, as CIGRE. Editor Robert McCaw covered this meeting for POWER ENGINEERING readers, and reports highlights in this issue. 50

Ever heard of using milk of magnesia to stop boiler tube corrosion? Better known as magnesium hydroxide or $MG(OH)_2$, this solution is blown dry into boiler furnaces at Linden Station of Public Service Electric and Gas Co. Chief Engineer R. A. Baker tells how they combat oil-ash corrosion and tube wastage. 58

Wright-Patterson Air Force Base, near Dayton, Ohio, was the scene of an important Heat-Power conference recently conducted by the United States Air Force. POWER ENGINEERING reports this high-level meeting of USAF power engineers from both domestic and foreign bases. Power field problems of common concern to both Industry and the Military got high priority. 68

WORLD'S TOP POWER ENGINEERS MEET IN PARIS FOR CIGRE CONFERENCE

BI-ANNUAL MEETING ATTRACTS AUTHORITIES IN FIELD OF HIGH-VOLTAGE TRANSMISSION

EUROPE WAS HOST to a second international power meeting during the month of June. Last month we reported the activities of the World Power Conference in Madrid. Now, we report on the CIGRE meeting in Paris.

CIGRE is the abbreviated name for Conference Internationale des Grand Reseaux Electriques. In other words, the International Conference on Large Electric Systems. This meeting is held in Paris every other year, and is attended by power engineers from all over the world. These experts are concerned primarily with the transmission and conversion of electric energy.

Prior to the actual meeting, papers are prepared by the various Study Groups on each of the subjects under discussion. Then, at the meeting in Paris, the papers are discussed by prominent engineers in the field.

Subjects covered at the CIGRE meeting were as follow: Power System Operation and Stability, Insulators, Surges, Direct Current, Extra High Voltage, Cables, Transformers, Overhead Lines, Towers, Generators, Relaying and Circuit Breakers. Abstracts of the various papers, together with discussion comments, will be given in the following columns.

United States was very ably represented at this meeting, and some of the most interesting discussion reports were given by this group. Editor McCaw covered both the World Power Conference and the CIGRE meeting, and offers herein some observations on the Paris meeting. After the Conference closed, several tours were arranged for the delegates. These tours permitted visitors to see some of the electrical facilities in France, and also to visit a number of other points of interest.

All of the reports and discussions were given in either English or French. Translators were on the job to translate into languages which were acceptable to all delegates. Worthy of note is the fact that two subjects, Direct Current and Insulators, were discussed at this meeting, and had not been considered at the last CIGRE meeting held in 1958.

Sessions were officially opened by Mr. Gianinne, Minister of Industry. Speeches followed by G. Silva, President of CIGRE, and M. Mollerhow and M. Vidmar, for the English and French-speaking groups. Quite an extensive talk on France's energy system, both electric and gas, was given by P. Ellerett, Assistant General Manager of Electricite de France.

System Planning

First session on the agenda was that concerning power system planning and stability. This dealt primarily with frequency control in inter-connected systems, mostly European. The problems seemed to be with types of governors on the generators, and the points of detection. Comment was made that the British favor replacement of governors on old turbines so that they will be more responsive to new techniques.

Morehouse, of Leeds & Northrup Co, U. S. A., gave one of the best discussions and described his company's work in frequency-control. There was a total of 15 speakers in this session. Most of the comments were general in nature and nothing too specific came from the session.

H. Sells, of the United States, gave

a good account of methods used in this country for station and system planning. It was pointed out that steady state stability has become more important in the U. S. than the increase in system size. Concordia, also of the U. S. A., discussed the use of computers in this country. He explained why the use of this equipment was more accurate than the simple use of system analysis by other methods. Apparently, computers are receiving wider use in this country than abroad.

Direct-Current Transmission

Operating experience on a number of direct-current lines was given in this discussion. Certain lines reported good experience, but it was generally felt that there was a lot to be desired in d-c transmission.

Mr. Kostenko, of Russia, gave operating data from the Kashira-Moscow line. He described the problems they had had, and how they had attempted to correct them.

Two new d-c projects are in the design stage now, one of them being a proposed channel-crossing under the English channel from Great Britain to France. The other is an 800-kv line in Russia.

It appears that, of the d-c systems which have been in operation for several years, considerable trouble has occurred in most of them. Generally, the trouble is not in the cable or conductors but in the equipment. Also, considerable problems in switching equipment and insulating transformers must be solved. On the next Russian system, a voltage of 800 kv has been established as a design criterion. They will use 8 series-connected valve circuits of 100 kv each.

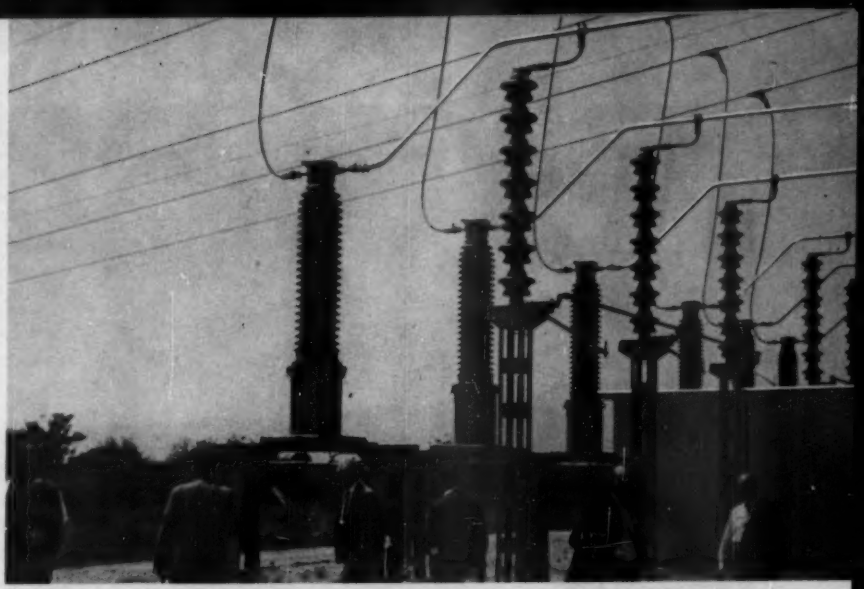


Fig. 1. Group of CIGRE delegates inspects EHV equipment at Le Chesnoy Sub

Apparently, d-c transmission in the United States is not being taken too seriously. However, in England a d-c testing station is to be developed for further research in this field. In general, the greatest problems yet to be solved are those of Valves and Radio Interference.

EHV Transmission

Philip Sporn of the United States, was chairman of this session, and some excellent discussions prevailed. The format of the discussions was spelled out by Mr. Cahen of France. The discussions were grouped into four parts; namely, the future of EHV, distances of transmission, operation of systems, and finally, corona loss and radio interference.

Considerable comment was made on the attempt to standardize voltages for future EHV lines. Generally, it was felt that 400, 500 and 700 kv should be good standards for all countries. Speakers from a number of countries expressed their views, and apparently not too much progress has been made in the field of standardization to date. Europe has some particular problems, in that interchanges of power occur across the boundaries of countries.

Sporn made clear the fact that it is not the function of a CIGRE committee to establish the standards. However, it should be a definite objective to recommend the standards. This thought was backed up by Diesendorf of Austria, who suggests that an international directive on future voltages to be studied by all countries should be issued, and hopes that steps will be taken in this direction. Lalander of Sweden stated that

Fig. 2. Opening of the 18th Convention of CIGRE, in Paris, June 15. Dr. Philip Sporn, of U. S., is third from left, front

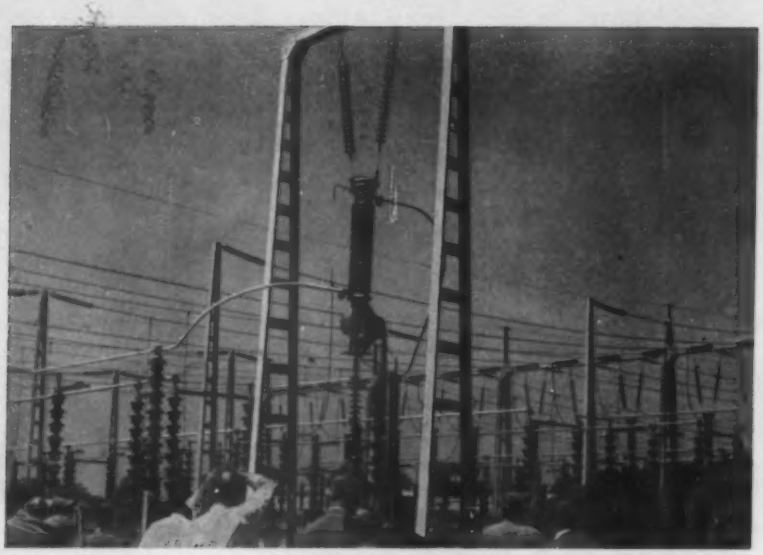


Fig. 3. Visitors inspecting circuit-breaker on EHV line at sub near Montereau

400 kv is standard in his country. They would like to have it higher but will stay with this voltage in the future because distances do not warrant extending it to a higher limit.

Discussion on Insulators

Contamination of the surface of insulators is of great importance to all operating utilities. Most of the session on insulators was devoted to this subject.

Considerable discussion evolved around the methods of testing, and apparently some uniformity in methods will soon result. Artificial pollution of insulators (prior to testing) was discussed. This seems to warrant further investigation. In other words, insulators to be tested in the laboratory will first be polluted with the type of contaminant which will be found in the area where the insulators will be installed. Of primary interest was the fact that *silicone* coatings for insulators have received widespread approval. Another unusual factor has been that increased temperatures, on the surface of insulators by means of an appropriate heater, prevent the formation of certain contaminants. One report stated that a coating of grease on insulators in tropical climates, particularly Pakistan, has given excellent results.

A new type of helicoidal insulator was described but did not obtain too much discussion from the group.

Problems With Lightning

Apparently, the rule-book concerning the effects of lightning discharges on transmission lines has to be revised slightly, with the increasing use of EHV transmission. Certain phenomena, applied on lines up to 110 kv, do not apply equally well to higher voltages. Mr. Kostenko, of Russia, described some experiments they had been running, which indicated that a wider angle of protection, as pertaining to the static wire, must be established for lines above 110 kv.

Scandinavia has developed a new lightning discharge-counter which will be a great aid in the study of lightning problems. Dr. Abetti, of the United States, described other new test equipment which has been produced for the study of lightning discharges, also.

In the reporter's summary, after the session on Lightning Surges, a conclusion was drawn that protection given by static wires was dependent upon many factors. One of the most important ones is that of the topography of the country in which the line is erected. Dr. Abetti referred to some data from Finland, where, through large forests, better performance had been obtained by the omission of static wires. On the other hand, the experience in Great Britain seems to indicate that static wires are considered necessary on all lines. There is a relationship between the two which ties in operating experience definitely with the topography of the country traversed.

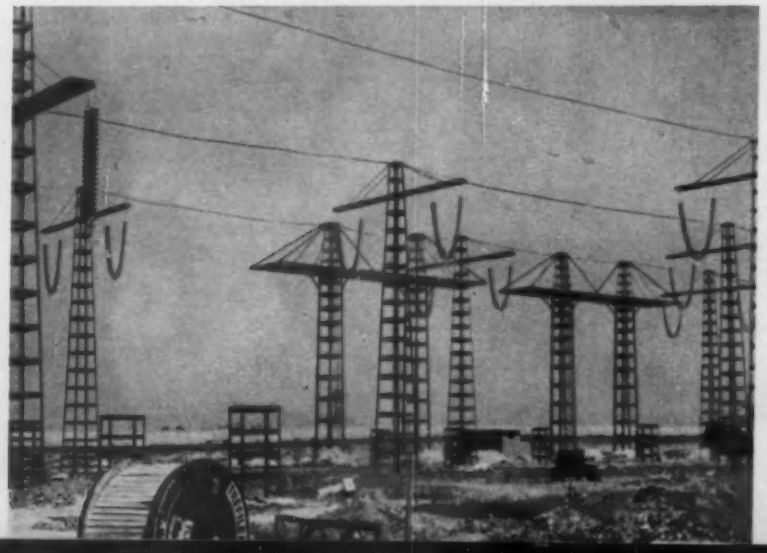
High-Voltage Cables

This session proved to be one of the most interesting of the entire conference. Many papers had been previously prepared and the discussions were quite extensive.

Considerable time was spent on remarks pertaining to submarine cables. Two are under considerable research at the moment; one being the cable under the English Channel; the other, a crossing under the Oslo Fjord. There does not exist, today, an ideal submarine cable (apparently) for laying at great depths.

Artificial cooling of cables came in for extensive discussion also. A number of methods have been tried, and future water-cooled cables appear to be very much in the limelight. In the matter of water-cooled cables, supply of water is one of the problems. This is under study at the moment, and several methods have been suggested for future consideration. Forced cool-

Fig. 4. Under construction, the new Le Chesnoy Switching Station. Also, a view of the structures which will support the EHV buses—at the Le Chesnoy Substation



ing of cables — by circulation of oil, gas or water — results in an increase in carrying capacity of about 50 per cent.

Pressures, in oil-filled cables, was talked about, also. There apparently is not a complete meeting of the minds on the pressure to be used for this application. In fact, it was suggested that in certain cases considerably improved operations could be obtained by varying the pressure, in some installations.

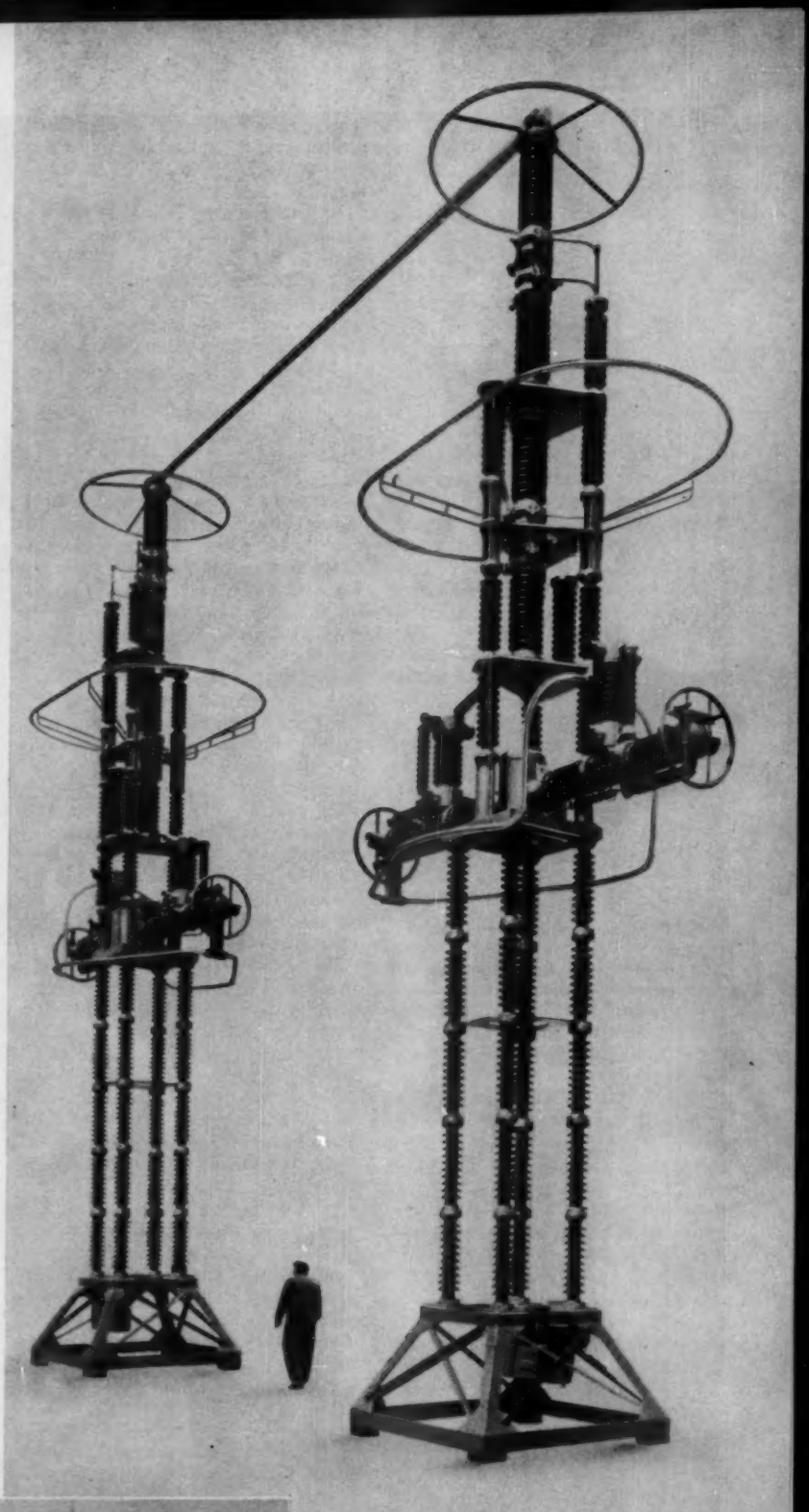
A bombshell was literally thrown into the cable session by Kenneth Wyatt, of Phelps Dodge Copper Co in the U. S. A. Wyatt suggested that we should consider rewriting the rule book of cable designs. He explained that for many years we have been using materials, such as paper, which have a definite affinity for moisture. He suggested that more research should be considered in the use of plastics. He said, too, that the molecules of the particular plastic should be designed specifically for the job. Also, he stated that several companies in the U. S. were doing a lot of research in this field, and felt that if considerable money is put into the research, the problem will be definitely licked.

Transformers

Interconnection of EHV transmission systems has resulted in much study into the matter of the use of auto-transformers. Several papers indicated that operations in this field have been quite satisfactory. Scale models of transformer stress-studies were explained, and indications were that this is a good avenue of approach to many problems.

Several papers discussed the methods of testing of transformers and capacitors, and indicated that considerable study must still be done in this field. The design of transformer windings received much attention in this session.

Preservation of insulating oil, in transformers, was discussed at great length; there is apparently a lot of continuing study required in this field. Paper insulation in transformers seems to warrant more investiga-



Figs. 5 and 6. Breaker of 525-kv rating, built for U.S.S.R. Group of Russian engineers is pictured at the left

tion; studies indicate that aging of paper is one of the primary causes of ultimate breakdown in insulation. (This might indicate that, like high-voltage cables, consideration should be given to the use of plastics, rather than paper, in this particular field.)

A very good paper by Haberl, Madill and Smith of Canada summarizes the extensive use of gas-detector relays in that country. A summary of this paper states the following: "Conclusion shows the value of the gas-detector relay, in comparison with transformer-differential protection, for suddenly occurring internal faults. It makes particular note of the phenomenal performance of the gas-accumulation alarm element, in detecting incipient faults at an early stage."

R. J. Kayser, of English Electric (Canada), had presented a paper regarding the use of high-voltage interconnecting auto-transformers — that gave some excellent information pertaining to the use of this equipment in Canada. He concluded by stating that this piece of equipment is now an economical and reliable link between EHV systems. A good part of the credit for this achievement goes to the system planners and designer engineers, who by close coöperation could work out realistic performance specifications, stated Mr. Kayser.

Towers and Foundations

Increasing costs, both in fabrication and installation, have resulted in some interesting tower designs — in several countries.

Recent developments in the form of tubular and guyed towers, and special foundations, were reported in this session. Conventional method of excavating and pouring concrete bases for towers has, in some geographical areas, presented extremely high costs. For this reason much study has been given to prefabricated foundations. Piling driven with portable equipment, in some regions, shows a definite decrease in installation cost.

Of late, the safety factors in tower designs have been questioned. Thorough study of designs, by the use of scale models (and full size towers), is taking place. Mr. Caillez, of France, reported on the encouraging results which French engineers have been able to obtain from the comparison of scale models and actual towers. Both a reduction in tower weight, and cost, have been obtained through this procedure.

Of course, those lines which are constructed in mountainous or otherwise rugged terrain naturally must receive more consideration than lines built in relatively flat country, where easy access is available to the tower location.

In the matter of new tower designs, we reported in POWER ENGINEERING — in July, p. 45 — on a new transmission tower, which has been designed and is in use in Sweden. It is claimed that this new design results in a cost reduction of approximately thirty per cent over previously used conventional construction. This tower was designed by the Engineering Department of the Swedish State Power Board, and its main features are that tower legs are slender and of uniform thickness, and stability is attained by means of four truss wires running from the cross arm to the ground. The outer loads of the cross arms cause pressure on the pole legs and tension on the stays. In one of these standard towers, the foundation is relatively small, and only 1800 lb of steel is needed.

A very interesting paper appeared on the design, construction, and erection of tubular towers in Scotland. The towers have a number of distinctive features. Graceful appearance and modular construction were outstanding. During the installation, experience has shown that erection time for a tubular tower is only one third of that for an equivalent tower of conventional steel-section, bolted construction.

In the erection phases, great savings in time were shown by the fact that there are only a few prefabricated sections to be bolted together at the site. This is contrasted to the conventional tower which must be constructed part-by-part. Time is saved in not having to sort out many steel members. The tubular sections are all prefabricated by welding special steel tubing on very accurate jigs; this permits the tower sections to be readily assembled on the site.

During transportation, a complete prefabricated tower (for 132-kv line construction) can be carried on a single five-ton truck. The smaller sections are telescoped into the larger sections to give a compact load.

To test the new tower design, a complete prototype tower was set up and tested in a special pit. The authors of a paper on this tower, H. B. Harvey and A. Erskine, report practically all advantages for the tower, with very few disadvantages. They do point out, however, that this form of unit-welded construction involves high shipping rates, and the tower can be applied economically in a country only where fabrication is carried out. However, they stated, in overseas work (or great distances), the material can be prepared and shipped in knocked-down fashion, and fabricated at its destination by local labor.

Overhead Transmission Lines

Damage to conductors, caused by vibration, was the subject of much discussion in this session. Damage particularly to ACSR conductors seems to occur in certain locations, and under certain conditions, to the suspension clamps, and at ground-wire attachments.

Considerable experience data was reported on Swedish line operations, in a paper by Bovallius, Persson and Sandstrom. Although their results would indicate that geographical location (and prevailing winds) have some effect on vibration damage, positive conclusions cannot be drawn until more experience is gained.

Some very interesting facts were given in a paper on overhead line construction by H. Caillez and A. Tilloy of France. This paper reports on studies made by French engineers of towers for EHV transmission lines.

Many styles of towers had been studied by this group, and certain conclusions are drawn from the studies. Generally, the greatest economy in tower design must come from a consideration of several factors; namely, the topography of the area, density of population, the nature of the terrain covered, labor costs, and other intangible factors. From these studies, conclusions can be drawn that no one particular type of tower is best suited for all locations in all countries.

Again, in this field, the use of scale models has come into play. A paper prepared by L. Paris of Italy disclosed studies made in the use of scale models for studying high-voltage transmission lines. Also, the use of a comparison between a scale model and an actual model line section.

In the general field of transmission line construction, a number of papers covered such items as bundled-conductors, suspension clamps, wind-loading, short-circuit testing, stringing methods and economic safety-factors. Most of these subjects are of long standing, and work continues in the fields of each.

On the subject of circuit-breakers, a number of points were discussed, mainly those that have been encountered in short-line load interruption and breaking of capacitor currents. None of these seems to be insur-

Fig. 7. Some of the excellent extra-high-voltage laboratory testing facilities, at the CERDA Lab, Lyons, France

Fig. 8. View of Roselend Hydroelectric dam, under construction, near Albertville, France. This is one of projects visited on post-CIGRE conference tours

mountable, and several suggestions were made for correction of the difficulties. Use of SF_6 in breakers was suggested by Brown and Leeds of Westinghouse. They claimed excellent properties of this material for arc extension. They reported on one breaker, for extremely high voltage, that is available on the market today.

Post-Conference Tours

At the completion of the technical conference sessions, several post-conference tours were specially planned for the delegates. One of the most interesting was the one into southern France, which included a visit to the Roselend Dam and power plant, a tour through the Lyons Cable Works, and a visit to the Cerda high-voltage research lab and manufacturing plant.

Also, for a break in the Conference sessions, some tours in and around Paris had been arranged. One of these was a trip to the Montereau steam plant. This is approximately fifty miles from Paris. A brief description of some of these facilities would be of interest to our readers, we believe.

First, the Roselend Dam and power plant form one of the most interesting projects in France. The plant is still under construction but is nearing completion. This afforded the delegates the opportunity of seeing all phases of hydro-turbine installations. The plant itself is underground near the town of Albertville, and has been cut out of solid rock. Outside the plant is a high-voltage substation which is in various stages of completion also.

Contrary to the usual type of hydro plant construction, this complex is not just a single dam and penstock. Rather, it is a series of tunnels which act as collector lines, or penstocks, from a number of water sources high in the hills.

Generating capacity of the plant is approximately 500,000 kw. One unique feature of the plant is that when completed it will be able to supply its full load capacity to the network within 3½ minutes.

This Roselend complex extends over a distance of nearly 40 kilo-

Editor and Wife Visit Roselend Dam On CIGRE Post-Conference Tour

TO KEEP POSTED on power developments around the world, POWER ENGINEERING's editors cover a lot of territory every year. Shown here are Editor Bob McCaw and wife, who were part of the group of CIGRE delegates on a post-conference tour in southern France. This photo was taken at the site of the Roselend Dam, which is described in this article. This group included engineers from many countries, and great interest was shown in the many unusual features of the project. Nearing completion, this power complex will go on line at the end of this year, and will add about 500,000 kw to the French power system.

meters (25 miles), and includes these basic elements:

1. The main dam at Roselend, plus its auxiliary reservoirs at La Chapelle, Saint-Guerin, and La Gittaz; 2. water intakes and supply facilities; 3. pressure tunnel and penstock; 4. underground power station at La Bathie; and 5. the high-tension substation near the power station.

Complete project is really a system of collection lines which gather smaller sources of water, high in the Savoy Alps, and funnel them into one main tunnel going to the plant. Another unusual feature of tne project is the fact that there is a metal-lined reinforced-concrete siphon across the Chapieux valley.

One unique feature is the fact that high up in the hills a small power station of 18,000 kilowatts utilizes some of the flow into the Roselend reservoir, before the water finally is collected downstream at the main reservoir. This small plant will produce 50,000,000 kwh in an average year. It will be remote-controlled from the main control station, which will also control the water levels in the various reservoirs and the emergency works.

One notable feature of the Roselend project is the fact that the single penstock, which goes directly into the power plant, is reputed to be the most powerful in the world. This is due to the fact that it was possible to concentrate 500,000 kilowatts of water-power into a single duct, because the most highly stressed part of it runs underground, where a large proportion of the load is absorbed by the surrounding rock.

Reasons for building the power station underground were these: 1. Lower head-losses in the penstock because of its reduced length; 2. savings obtained by building the bottom part of the penstock as a single underground shaft (an above-ground layout would have involved twin penstocks); 3. absence of expensive foundations for a powerhouse standing on alluvial ground, with a well-developed water table. These advantages offset the additional excavation costs due to underground rock excavation.

Power plant has six 83,000-kw Pelton turbines, running at 428 rpm, under a head of 3900 ft.

Each of the generators is connected to a separate transformer. Two of these step the voltage up to 225 kv, the other four generators to 400 kv. All of the transformers are installed close to their respective alternators, thus eliminating any need for expensive medium-voltage bus equipment. From this point, high-voltage cables run to the switchyard outside through 200- and 400-kv oil-insulated cables.

On the downstream side of the plant, water from the turbines is returned to the Isere River by an open tailrace. The plant construction was started in 1956 and is scheduled to begin peak load operations by the end of this year.

Although this plant is not unique in size, its unusual features make it one of the most interesting hydroelectric projects on record.

On this same post-conference tour, we visited the Lyons Cable Works, where practically all types of wire and cable are manufactured. This was a most interesting visit and gave the delegates a chance to see some unusual types of regular and high-voltage cable in production.

Finally, on the tour, a visit was made to the Cerda high-voltage research laboratory and manufacturing plant. Here, research has been done for extra-high-voltage switchgear, and the production plant has produced some of the highest-voltage gear now in operation.

The visit to the Montereau steam plant permitted us to see a plant which is more or less maintained as a stand-by plant for Paris. It has two 150-megawatt turbines and generates at 15,000 volts. Boilers and turbines were built by the French concern of Stein-Robaix-Alsthom. It is a conventional steam plant, and the voltage is stepped up to 225 kv at the plant. Then it is sent through underground cables to a nearby substation at Le Chesnoy, about one mile away. At the time of the visit, one of the turbines had been opened for complete inspection.

Manufacturer and owner were coöperating to inspect the unit because it was the first of its size and type built in France. The plant is quite new. One unit is two years old and the other is only one year old. The high-tension substation at Le Chesnoy nearby was under construction. It presented a novel opportunity to inspect several voltages of switchgear. It is both a switching station and a terminal substation. Lines of 63, 225 and 380 kv go out of this station.

At the Montereau station, all coal is received by rail. The plant has a very elaborate coal-handling system, and a very extensive coal-storage operation. . THE END

Fig. 9. Photo, inside power plant, at La Bathie, a part of the Roselend project

LINDEN COMBATS BOILER TUBE CORROSION WITH $Mg(OH)_2$

AT LINDEN STATION, DRY MILK OF MAGNESIA, $Mg(OH)_2$, IS BLOWN INTO BOILER FURNACES, TO COMBAT OIL-ASH CORROSION

AS TOLD HERE BY R. A. BAKER, CHIEF ENGINEER, P.S.E. & G. CO.

AT THE LINDEN Generating Station of Public Service Electric & Gas Co, with steam temperatures of 1050 and 1100 F, they are faced with the problem of boiler tube wastage caused by oil-ash corrosion.

This plant burns in its four boilers a residual fuel oil, supplied from a refinery located adjacent to the property. Linden Generating Station was especially designed for supplying process steam to the refinery in exchange for fuel and water.

The fuel oil supplied to Linden contains vanadium, which, with other constituents, forms an ash that causes the tube corrosion. This corrosion is being combatted by injecting dry milk of magnesia, magnesium hydroxide, $Mg(OH)_2$, into the boiler furnaces just above the burners, to mix with the combustion gases. The resulting ash on the tubes appears dry rather than molten, and this change reduces the corrosive action. Technical data on the results of this work have been accumulated for over a year, but at this writing they have not been completely evaluated.

Many utility plants on both East and West coasts burn residuals containing vanadium as high as 500 to 600 ppm. The high vanadium, together with sulfur and sodium, is blamed for the corrosion that occurs at tube metal temperatures around 1100 F.

Since 1951 a great deal of test work in use of various alloys and fuel oil additives, to combat boiler tube corrosion, has been done by various organizations, including our own. As a result of all this test work, it was decided at Linden to use magnesium hydroxide as the additive and to blow it dry into the boiler furnaces, to mix with the combustion gases. The hydroxide was chosen primarily because it handles better than the oxide, which tends to pick up moisture and plug piping and feeding devices. This is how it is being done:

Additive System Details

Figure 3 diagrammatically shows the additive system. As shown, four boilers are installed at Linden. Three boilers, of 1,000,000-lb-per-hr capacity each, are installed with turbine generator No. 1, a 225-Mw double-extraction condensing unit, with steam conditions of 2000 psig, 1050 F, supplying 750-psig and 150-psig extraction steam to the refinery. The fourth boiler is a 1,900,000-lb-per-hr, twin-furnace unit, supplying steam to a 225-Mw, single-extraction turbine generator unit with steam conditions of 2350 psig, 1100/1050 F, with 150-psig extraction steam to the refinery.

The fuel oil additive system for these boilers is designed to combat oil-ash corrosion by adding continuously to each furnace a maximum of 160 lb per hr of magnesium hydroxide powder ground to a fineness of 90 per cent through a 325-mesh screen. Magnesium hydroxide is received in railroad cars and unloaded into a two-week-capacity storage silo through a pneumatic system. The unloading rate is 10 tons per hour, which will enable a railroad car to be emptied in approximately four hours.

The car-unloading system is designed to handle either hopper-bottom cars or box freight cars by means of a sled-type device or a flexible suc-

Fig. 1 (Above). This is a close-up view of the additive feeding devices at Linden Station, showing one aeration hopper, rotary gate valve, and feeder. Fig. 2. This is a general view of the additive storage silo and additive feeding devices. Supply piping to the boilers is visible at the top on the side of the pipe bridge

tion pipe. Located above the silo is a dust separator and a suction blower. The suction blower creates a vacuum on the unloading system, and both additive and conveying air are admitted into the pipe to the silo. The additive is caught in the separator and passed through a rotary feeder into the silo. Filter bags in the separator remove the dust from the conveying air before the air is discharged to atmosphere.

The silo is equipped with three level indicators to show the height of the additive in the silo. A filter is located over the silo vent. This vent collector prevents pressurization of the silo due to operation of the aeration pads at the sill bottom and also prevents additive from entering the atmosphere.

Additive Feed

On the bottom of the silo are five aeration hoppers, each discharging through a manually operated rotary gate valve. Connected to the valve is a motor-operated feeder, which operates intermittently to maintain the level in the metering hopper. A variable-speed rotary feeder, connected to the metering hopper, discharges the additive into a sampling hopper at the desired rate. An eductor, using dry 15-psig air from the compressed air system, creates a slight vacuum in the hopper and furnishes the air to transport the additive into the furnace.

A 2-in. pipe runs from each feeder to a furnace, the longest run being approximately 300 ft. Above the windbox on each furnace, the line divides, and the additive is distributed equally to four ¾-in. pipes. These pipes extend through the windbox into the circular burner opening and are about flush with the front wall tubes. At each burner, there is an aspirator for maintenance of the ¾-in. pipe going into the burner. This is required because these furnaces are operating at around 10 in. of water pressure.

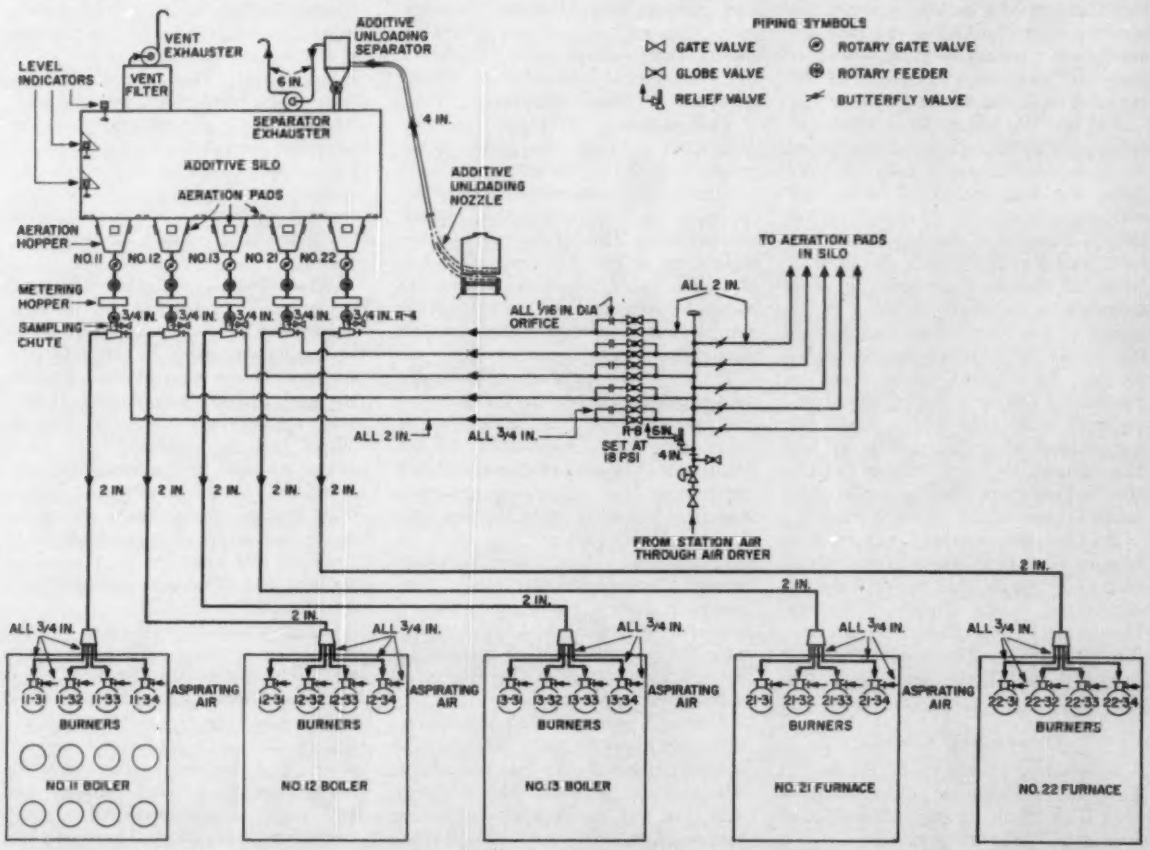
Additive feed to each furnace is controlled to maintain a ratio of two parts magnesium to one part vanadium. Pilot plant tests indicated that below one-and-a-half to one would cause a fouling condition in the boiler gas passes. The vanadium content of the residual fuel oil burned at Linden may vary from 100 ppm to 500 ppm. However, an average typical analysis shows 350 to 400 ppm of vanadium.

Addition of magnesium hydroxide to the furnace very definitely increases the amount of deposit on the tube surfaces. However, it is a dry, fluffy deposit that can be removed with soot blowers.

In test work with additives, it has been observed that there is some reduction of fouling of air heater surfaces. However, at Linden, due to very low exit gas temperatures, in the range of 200 F, the practice is to wash the heaters about every three months, and there does not appear to be any benefit here from the use of the additive.

Magnesium in dry powdered form is manufactured by several chemical companies. One of the factors that is presently being evaluated is whether or not some types of magnesium oxide can be handled easily and are as effective in combating corrosion as magnesium hydroxide. The current cost of this material is $67 per ton delivered in bulk at Linden Generating Station. This amounts to approximately 1.5 cents per barrel of fuel on a vanadium content of 300 ppm. THE END

Fig. 3. Schematic diagram of fuel oil additive system installed to supply powered magnesium hydroxide to four boilers



METHODS OF CHECKING STEAM CONDENSER PERFORMANCE

ENGINEERS R. A. WILSON AND R. H. JOOST, OF ALLIS-CHALMERS, CONTINUE THIS SERIES BY EXPLAINING PERFORMANCE TESTING

NEED for performance testing can best be illustrated by an example.

Frequently the turbine nameplate specifies a certain vacuum, and the plant cycle is more or less based on this vacuum. If the condenser gives this vacuum or a better vacuum, the operators are inclined to say that the condenser vacuum is good, which it may be from the standpoint of the cycle or from the turbine.

But at the same time that the condenser vacuum is good compared to cycle conditions, it may be poor from the standpoint of what the condenser is capable of doing, and it may indicate that the condenser performance is actually poor due to dirty tubes or excessive air leakage. This situation is especially evident in the spring of the year, when the circulating water inlet temperature begins to rise. In a great many cases all concerned are very happy about the vacuum with cold water, until the inlet water temperature goes up and the vacuum then suffers due both to the temperature rise and the poor performance which already existed.

So that the operator will be able to spot such problems at their inception and thus be able to avoid similar situations, some simple operators' checks are here proposed. Detail testing with emphasis on the instruments involved and their use is also discussed.

Operators' Checks

Operators' checks on a unit do not have to be elaborate to be informative. The following suggested method would be quite adequate.

It is desirable to get a rated load or some agreed-upon load on the turbine which will be the same for each successive check and read the load, air leakage, inlet water temperature, outlet water temperature and the absolute pressure in this condenser, and convert the absolute pressure into the corresponding saturated steam temperature; also, calculate the rise, initial temperature difference, and terminal difference.

The terminal difference is the difference between the steam temperature and the outlet water temperature; the temperature rise is the increase in the circulating water temperature. The initial temperature difference is the difference between the inlet water temperature and the steam temperature (or the saturation temperature corresponding to the absolute pressure).

If this data is recorded periodically and checked, any deviation will give the operator the best indication of what has been happening to his condenser. Figure 1 shows simulated conditions that might be expected during a period of time from a condenser. First, one of low gpm or tube-plugging affects the following values: absolute pressure, steam temperature, outlet water temperature, terminal difference and temperature rise. By backwashing or alleviating the low gpm situation the condenser is returned to normal.

During a period of high air leakage, when air blankets tube surfaces, the absolute pressure, air leakage, steam temperature, and terminal difference will rise, and again upon correcting the leakage, will return to normal. Also, during a period of dirty condenser tubes, the absolute pressure, steam temperature, and terminal difference increase, and after cleaning will return to normal.

Other Factors

Other factors which would affect the condenser trend are the change in water inlet temperatures and change in loads. These changes do not affect the condenser performance although they change most of the condenser temperature values and do change the turbine back-pressure. As a guide to condenser performance the terminal difference gives the operator the alarm and should be watched carefully.

Data taken at a different load may be compared to that at the desired load by the following device. Load to the condenser, either in terms of Btu per hour or kw load plotted against rise and initial temperature difference, appears as shown in Fig. 2. "Rise" will be a straight line from zero at no load to the maximum rise at full load. Disregarding the effects of air leakage and vacuum pump capacity and some of these matters in the very low load range, the initial temperature difference will also be a straight line.

Difference between the rise and the initial temperature difference represents the "terminal difference." This terminal difference can also be plotted on the same curve, and the line will also be straight for all practical purposes. The rise will be the same line for all operating conditions of load and water temperature for a given circulating water flow. There will be a

separate curve for the initial temperature difference and the terminal difference for various inlet water temperatures.

In taking this data, some consideration should be given to the instruments used. In the plant there should be an accurate barometer and vacuum gage. The difference between these gives the absolute pressure which is used in evaluating cycle and turbine performance and is, of course, important condenser data. The method used to determine the circulating water inlet and outlet temperatures should be accurate. In general, the ordinary operators' recording thermometers in the control room and dial thermometers on the circulating water inlet and outlet pipes are not accurate for this purpose. Industrial mercury-type thermometers should remain accurate for the life of the plant and should be adequate. The operators should have instruments such as these at their own disposal.

An air meter should be available and arranged so that an operator can simply measure the air discharge from the air removal equipment at any time, especially when some new operating condition has occurred or when the condenser performance looks peculiar.

Operators should watch pump discharge pressures and pump horsepower for clues as to tube sheets plugged by rubbish accumulation. It is even better to have measurements of pressure loss across the condenser from inlet to outlet water boxes.

In case of low vacuum or poor performance, all of these should be checked. The operator may want to put on an extra vacuum pump or an extra steam jet element. If this cures a vacuum deficiency, then air leakage should be reduced. Acid cleaning, for example, will not correct excess air in-leakage or too small a vacuum pump capacity.

If the oxygen in the condensate is reported high, some simple operating checks can help find the trouble. If an extra vacuum pump or steam jet element cures the trouble, then run the extra vacuum pump until the air leakage can be reduced. If increasing air leakage 50 per cent by bleeding air in at the condenser inlet with normal vacuum pump capacity does not make the condensate oxygen worse, then normal air leakage is not the big trouble. In this case change condensate pumps, tighten up packing on fittings below the condensate

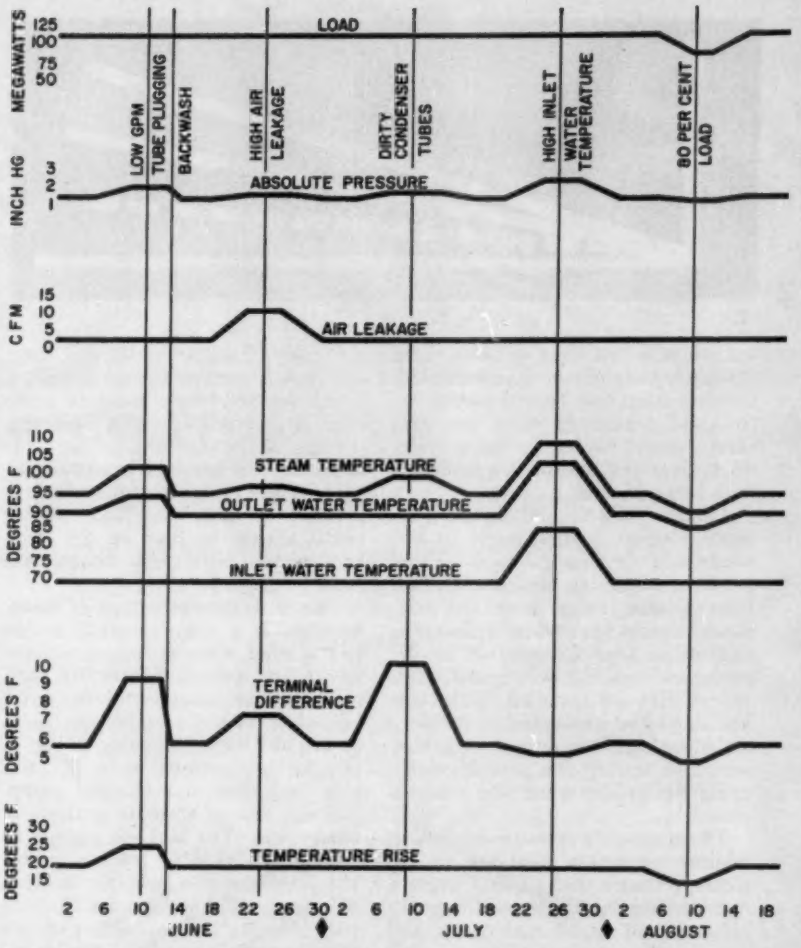


Fig. 1. Conditions that might be expected during a period of time from a condenser

level in the hotwell; check for leaks below the hotwell level.

High air leakage or low vacuum pump capacity will hurt performance at all loads and especially at low loads.

Poor heat transfer due to tube fouling will affect vacuum performance at all loads but will be most noticeable at high loads.

Detail Testing

In detail testing, more specialized instruments are used and more consideration is given to their use. This will be applied to some of the basic measurements.

In the determination of the absolute pressure, to insure that a true average static pressure reading will be obtained, adequate and strategic locations of pressure-measuring points should be chosen.

These locations should take into account pressure deviations introduced by heater drain lines, dump lines, heaters, braces, wall effects, and turbine wheel rotation. Most of these effects will be taken care of by locating the measuring points a sufficient distance away from lines, tanks, braces and walls.

The pressure-measurement point should not be more than three feet above the top row of condenser tubes; the number of points, as a general rule, should be one point for every 16 sq ft of exhaust area, with a maximum of eight points. In this high-velocity area, a pressure tip should be used to insure that the static pressure is measured.

Any discrepancy of 1/10-in. of mercury or more between pressure-measuring points around the periphery of the condenser exhaust neck indicates that readings should be retaken and/or investigated. For permanent test lines leading from the pressure tip to the pressure-measuring equipment, lines of $\frac{3}{8}$-in. ID tubing or piping should be used with a minimum number of connections.

In plants where condensation in test lines is a factor, minimum ID that should be used is $\frac{1}{2}$-in. Con-

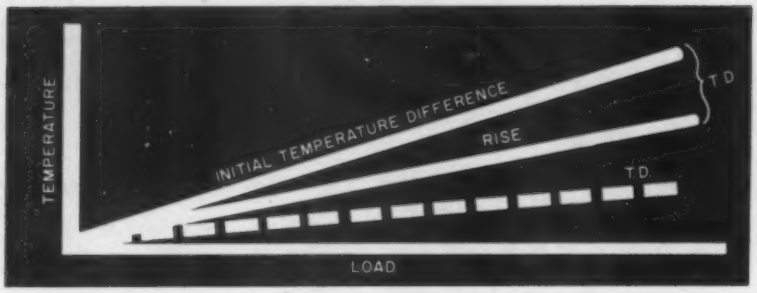


Fig. 2. Effect of changing condenser load on operating variables. Load can be plotted either in Btu/hr or in kw

densation in test lines will give more trouble in the summer than in winter. Condensation may be expected when the inlet circulating water temperature is about 65 deg or higher for a single-pass unit and 60 deg or better for a two-pass unit.

All test lines should be continuously pitched leading back to the condenser, or else pitched to the pressure-measuring equipment. Test lines pitched away from the condenser should have water drain traps located as near as possible to the pressure-measuring equipment. Any valves that are installed in the test line should be positioned so that any air in-leakage through the packing would be toward the pressure-measuring equipment when the valve is closed.

Three absolute pressure-measuring devices commonly used are an absolute pressure dial type of gage, a combination barometer and mercury column, and an oil manometer and associated equipment.

Absolute pressure dial type of gages have a deviation of 0.01-in. of mercury with ranges of 0 to 2 in. and 0 to 4 in. of mercury.

Combination barometer and mercury column is another good way of measuring condenser absolute pressure. By deducting the observed reading on the mercury vacuum column from the barometric pressure as read on the barometer, the absolute pressure is obtained. Both instruments should be read on the same level or else an elevation correction must be applied.

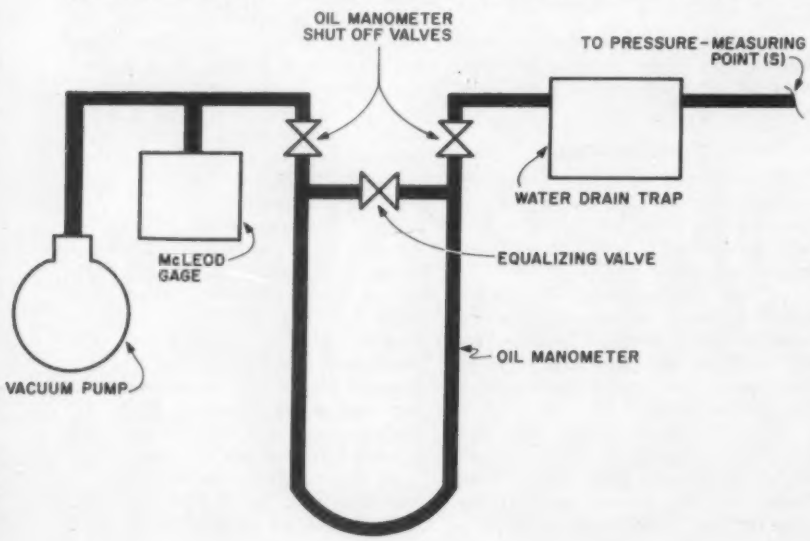
The oil manometer type of measurement is a very accurate device and is used when stringent requirements are needed. Measuring fluid used in the manometer is butyl phthalate with a specific gravity at 80 deg of 1.0406. Referring to Fig. 3, one leg is connected to a McLeod gage and then to a vacuum pump. This leg has an absolute pressure of nearly zero. The McLeod gage is an instrument used to read very low absolute pressures, usually in microns of mercury. This is about one 25,000th part of an inch. Usual reading on this gage is around 20 microns of mercury. Other leg of the oil manometer is connected to the condenser and the various pressure test lines.

All test lines leading from the condenser to any absolute pressure device must be as tight as possible since any in-leakage of air can give a false reading. As an indication of tightness in the test lines, when the condenser is isolated from the test apparatus, a rise of ½-in. of oil per minute in the manometer, due to air in-leakage, can be tolerated.

Another difficult thing to determine when making a condenser performance test is the steam condensing duty. The duty that is attributed to the condenser is the amount of heat removed by the condenser from the main steam flow of the turbine and all drains entering the condenser at higher temperatures than that of the exhaust steam temperature.

During a test run it is necessary to isolate the condenser unit as much as possible and check hotwell and make-up water levels at the start and the end of tests. No heat or steam or water should be added to the unit during this time. Most units will be instrumented, so it is possible to make a heat and material balance to and from the turbine and extraction heaters. This will usually give a close approximation on the heat load to the condenser.

Fig. 3. Schematic of oil manometer equipment for absolute pressure measurements



Circulating Water Data

It is also usually practical to use circulating water pump data to approximate water flow which with rise in circulating water temperature gives another approximation of heat load. During turbine tests, these quantities are checked as accurately as possible. Ideally, condenser and turbine tests should be run at the same time. Values determined from turbine tests do help check flowmeter and instrumentation, and may be helpful in making future periodic routine checks on condenser performance.

Circulating water temperature determination is fairly straightforward so far as variables are concerned. On each inlet line there should be two thermometers to note temperature. A minimum of four thermometers should be used on each circulating water outlet line. Temperature stratification on the circulating water outlet of a condenser can be quite serious. Variation of two degrees around the periphery of a large tail pipe is not uncommon. When one considers a condenser with a rise of ten degrees, an error of one degree F

Continued on page 92

NEW BARGE SNUBBER IS BIG COST-SAVER

DEVICE CURES OLD HEADACHE IN BARGE UNLOADING, AND SHOWS GREAT SAVINGS IN TIME AND HAWSER EXPENSE

SAID TO SAVE thousands of dollars a year in 2-in. hawser, and time, a new automatic coal barge snubber has been introduced.

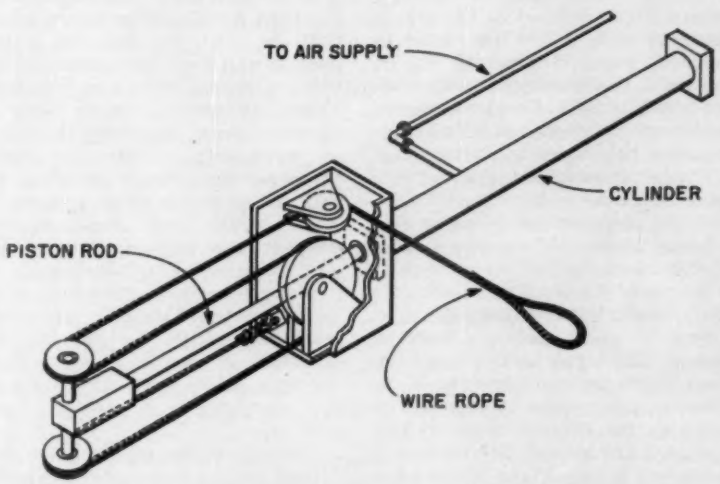
The Pratt Barge Snubber is a constant-tension device which secures the barge to the dock with wire rope. Tension is obtained from an air cylinder which operates to push a crosshead away from the cylinder, thus creating a constant pull. When air pressure is reversed, the rope is free to be "pulled" in any direction for attaching to the barge.

The barge snubber is essentially an air (or other fluids, if high-pressure supply is available) tensioning device having an extendable cable length of 26 feet. It is installed on the deck of a dock — fairly close to the edge (about 4 ft) — and is used to hold barges to the dock edge regardless of variations in level changes, loading or unloading, or bumping from other barges.

When it is desired to tie up a barge, the dock helper turns the control valve of the snubber to "off" position. The cable loop is affixed to the barge, and the control lever is moved to "on." The constant-tension snubber then "pulls" the barge up to the dock edge and holds it there under constant tension.

Use of these snubbers reputedly saves thousands of dollars in heavy 2-in. hawser, which ordinarily would be broken due to barge level shifts. Additionally, only one man is needed to put the snubber into operation — from that point until unloading is completed, no manual operations are necessary.

For more information, write the Editor, POWER ENGINEERING, 308 E. James St, Barrington, Illinois.



POLYELECTROLYTE IMPROVES REFINERY WATER SUPPLY

USE of a new flocculent in raw water treatment is enabling Sohio's No. 1 Refinery at Cleveland, Ohio, to save $7200 per year in chemical costs. So reports C. D. Crawford, the refinery's superintendent of utility dept. Furthermore, the quality of the treated water now approaches city water in clarity. This will result in more savings at refinery units where the water is used. Crawford has prepared the following description of Sohio's experience with the new flocculent:

Source of Sohio's No. 1 Refinery's raw water is the Cuyahoga River, at a location about one mile from its mouth. The water at this point has been used many times over by Cleveland's prolific industries. It contains the effluent from Akron's sewage plant as well as Cleveland's Southerly Sewage Plant. Waste products from Cleveland's steel mills and chemical plants further contaminate it. Floods and storms add to the treating problems. Heavy-laden ore boats, going up river past the intake, stir up the bottom and cause the river to rile up as badly as from a heavy rain.

Fish in the Cuyahoga River are nonexistent (except during a prolonged steel strike). The river has frozen over only once during the working years of the writer. In the summer months, the oxygen content drops to zero and the river's temperature rises as high as 108 F. At times, the detergent content of the river causes foam to pile up six feet high at the intake. Thus there are many variables to contend with in treating the water.

Principal use of the treated water is for cooling tower make-up. Sohio has been using cooling towers since 1931. In 1942, the first raw water treating unit went into operation. In 1952, a second unit was installed. These raw water treaters were a big step toward improving the refinery water supply. Today the 55,000 barrel-per-day refinery is served by two cooling towers whose capacity is some 50,000 gpm. Some of the treated water is pumped two miles away to Sohio's No. 2 Refinery.

Many coagulants have been tried in the treaters. Originally alum was used. Since 1945, the principal coagulant has been lime. Along with the lime, alum, ferric sulphate, sodium aluminate and copperas have been tried.

Best previous results were obtained with lime and copperas. Sometimes lime alone gave good results; at other times it was necessary to add copperas. After storms, the treaters would upset no matter what was fed.

In 1958, a coagulant aid was added, which was a mixture of bentonite clay and a polyelectrolyte. The coagulant aid was fed along with the copperas in the ratio of 1 part aid to 3 parts copperas. An evaluation at the end of the year showed that the cost of this treatment was high and that the water quality had not improved enough to justify the additional treating cost.

Decision was made to try SNP-10. Jar tests using the chemical were very encouraging. SNP-10 is a high molecular weight polyacrylamide. It has the ability to cause small floc particles to draw together into a tight, compact, dense floc. This was

Fig. 1. This view shows the two treaters which process raw water used in make-up for refinery's cooling towers

COMPARATIVE COSTS OF TWO TREATMENTS

	1958 Pounds	1958 Dollars	1960-Predicted Pounds	1960-Predicted Dollars
Coagulant Aid	65,800	4,424	——	——
SNP-10	——	——	3,650	4,200
Copperas	200,700	6,913	6,000	168
Lime	824,175	8,489	802,000	8,250
		19,826		12,618

WATER ANALYSES IN 1958

		Raw River Water	Treated Water
Hydroxide	(OH)	0 PPM	0 PPM
Carbonate	(CO_3)	0	26
Dicarbonate	(HCO_3)	75	12
Sulfate	(SO_4)	260	220
Chloride	(CL)	71	73
Aluminum	(AL)	0.20	0.05
Iron	(Fe)	12	1
Calcium	(CA)	69	72
Magnesium	(Mg)	13	10
Hardness	(as $CACO_3$)	226	220
Synthetic Detergent		1.8	2
pH		6.2	9.8

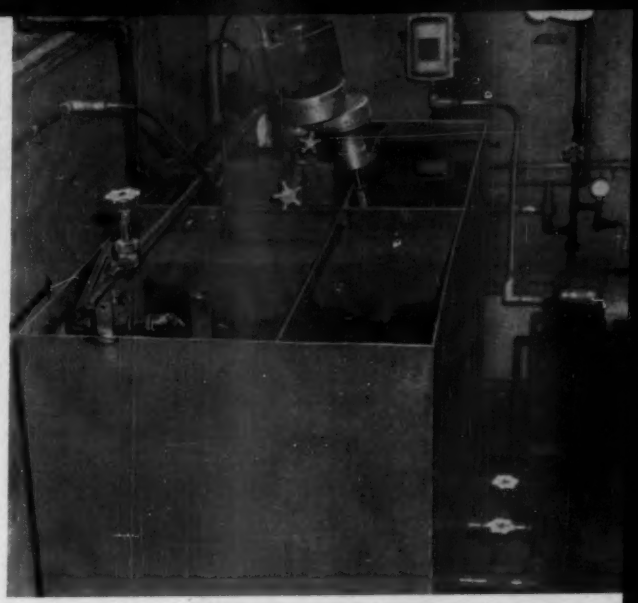


Fig. 2. The two solution tanks for handling SNP-10, mixer and the metering pump

what was lacking in our process. Much of the time the treaters carried over a fine floc. This floc contained iron which was particularly detrimental to the cooling tower system.

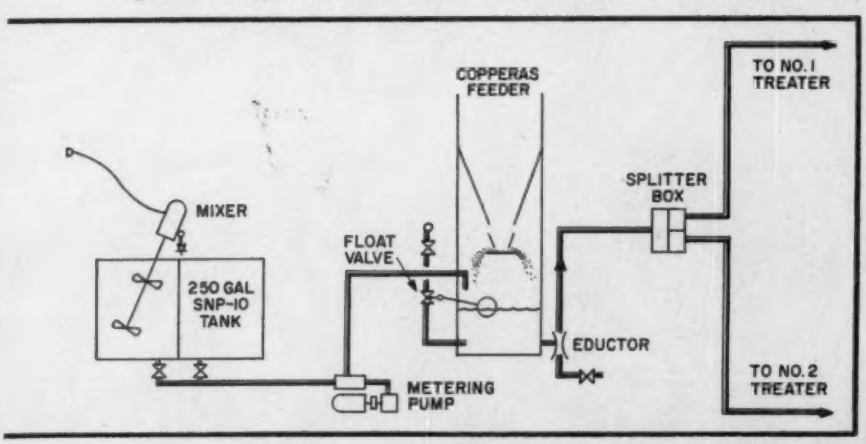
Figure 3 shows the flow diagram of the SNP-10 feed system. Two solution tanks, a mixer and a metering pump were all that was necessary to add to our equipment. The SNP-10 solution is fed into the copperas feeder dissolving pot, and from here it is pumped with a water eductor to a splitter box from which it flows by gravity to the influent chambers of the treaters.

SNP-10 is extremely difficult to dissolve. The mixing tanks were designed for mixes of ½ per cent solution. Thus two 250-gal tanks were installed for feeding 10 lb of SNP-10 per day. When making a mix the chemical is slowly sifted into the tank as the make-up water is added. Care must be taken to sift it in slowly in such a manner that the flakes are wetted before they have a chance to congeal into a ball. It is like making gravy. If all the flour is dumped into the gravy stock at once, a mess results. Dissolving baskets are useless and will not work. Once the chemical has been added successfully to the water, the mixer dissolves it in about one hour. A mix is made in one tank, and the pump feeds from the other tank. Tanks are large enough so that a mix lasts 24 hours.

SNP-10 is fed to the treaters at a dosage of 0.5 ppm. Since the start-up of the new facilities, the quality of the treated water has been so good that the copperas has been eliminated. However, some copperas will be fed after heavy storms.

Lime, the main coagulating agent, is slaked in continuous proportional feed slakers and educted to the treater influent chambers. The lime feed averages 0.97 lb per 1000 gal of raw water. Control point on the lime has been set at 2P-MO = 30. Range of 20 to 40 is close enough to give good results.

Fig. 3. Flow diagram of the SNP-10 feed system. Ten lb of SNP-10 are used daily



Cost of installing the feeding equipment was $1313. This does not include the cost of the metering pump and mixer which were picked up from surplus equipment.

Benefits from the use of SNP-10 include the following:

Clarity of the treated water has approached filtered city water.

Iron carryover has been lowered. Iron content of the circulating water in the cooling tower systems has shown a reduction from 3.0 ppm to 0.7 ppm. Iron has been one of the principal fouling agents in refinery process unit coolers, and its removal is both difficult and costly.

More Good Results

The treaters have been more stable since the feed of SNP-10 began. Sludge blanket stays down where it belongs. Fine particles of sludge that used to escape the blanket and rise to the overflow are now kept within the blanket.

Chemical handling has been reduced. Ten pounds a day of SNP-10 has taken the place of 600 lb of copperas and 200 lb of coagulant aid.

With better water make-up to the cooling towers, fouling problems in the refinery process units will be less severe. Cleaning costs of coolers will be reduced, and chemical treatment of water in the cooling tower systems will be more effective.

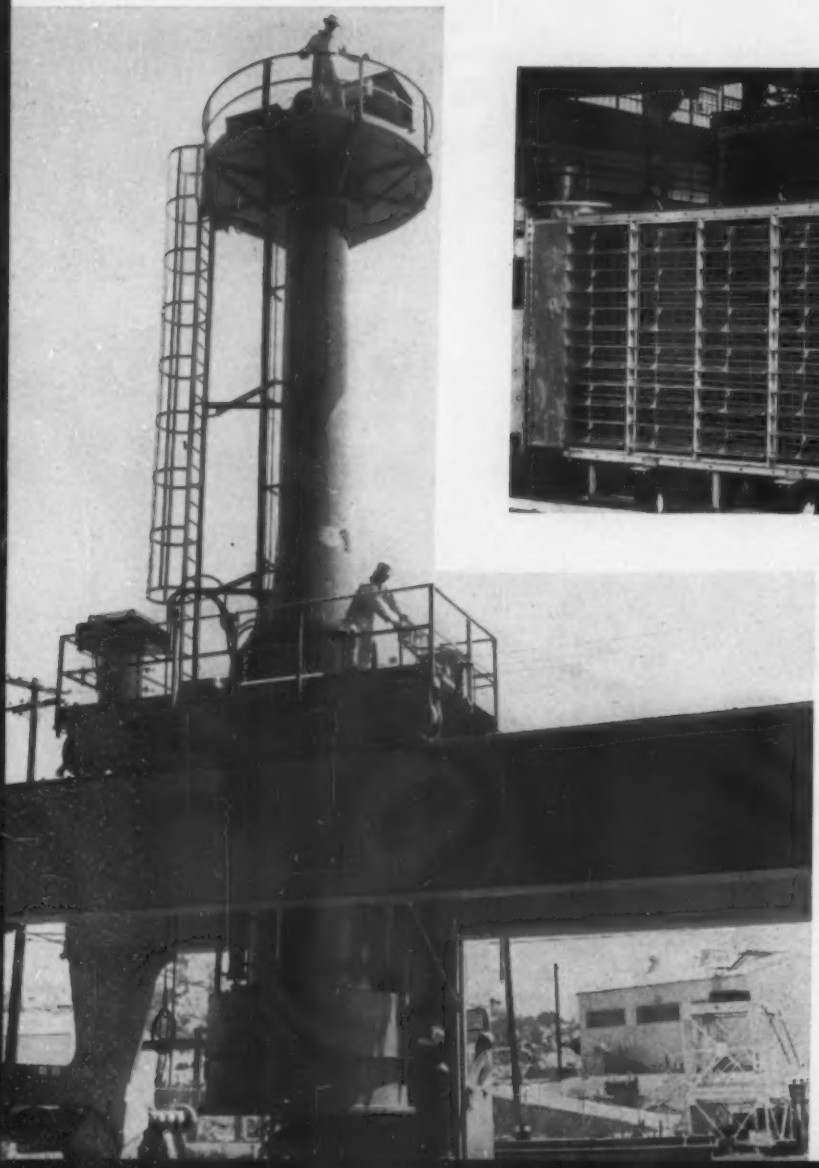
Costs of water treating have been reduced $7200 per year.

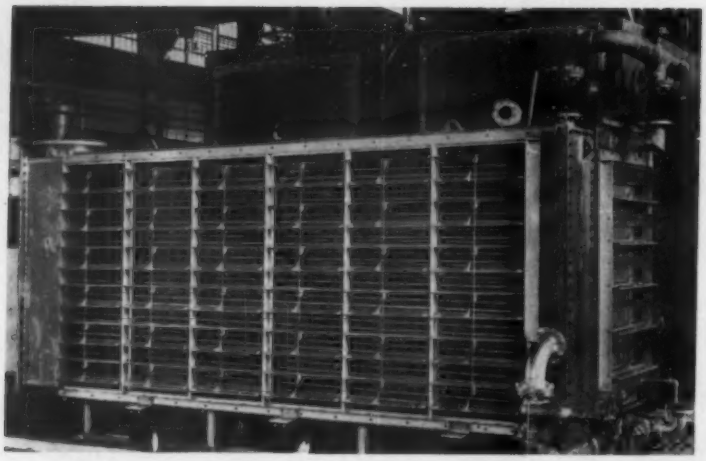
For more information on SNP-10, write The Editor, POWER ENGINEERING, or jot SNP-10 on the postcard inserted in this issue. THE END

Yankee Atomic Electric plant at Rowe, Mass., went critical on August 19. This 136-mw station is the first nuclear-powered electric generating station in New England. Reactor is latest in water-cooled and moderated type

Electrical energy for Boeing's new hypervelocity wind tunnel is built up and stored in 2280 capacitors capable of delivering an impulse equivalent to 5 million horsepower. Tunnel speeds can range from 20 to 18,000 mph

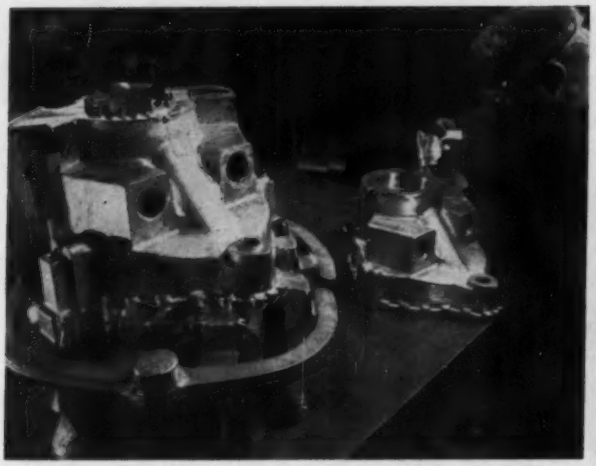
Power Engineering's





Test model steam-to-air condenser, 8 ft wide by 8 ft high by 20 ft long, is part of a project by Westinghouse and the Martin Co to build a portable nuclear power plant. Condenser operates in temperatures from 125 F to −60 F

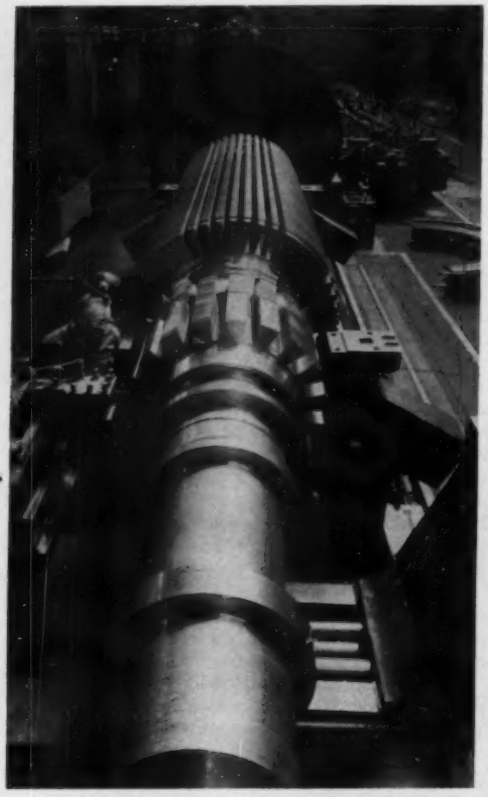
Atomic fuel loader, 54 ft high, will handle reactor components at AEC's 75,000-kw Hallam facility in Nebraska. Loader was built by Atomics International, is shown under test. Hallam is scheduled for completion in 1962



Aluminum castings are reduction unit output housings for Boeing's newest 400-hp turboprop gas turbine engine

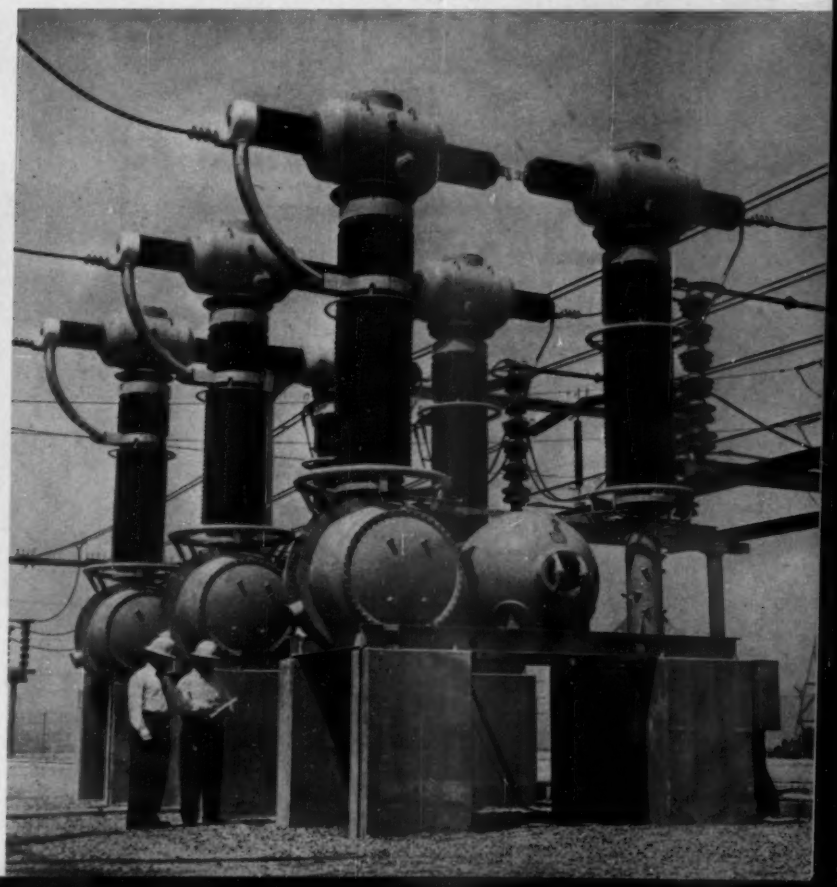
Automated G-E numerically-controlled turret drill finishes last of 17,200 perfectly spaced holes in plates for a power plant. Job was done in 3 weeks

NEWS REEL



Almost 75 tons in weight and 5 ft in diam this nickel-molybdenum steel forging for a 4-pole generator rotor will be part of ConEd's 357-mw Astoria Unit 5 in New York. It's being machined at Allis-Chalmers

These breakers, non-oil filled, are rated 230 kv, 1600 cmp, interrupting rate of 15 million kva. Made by GE for Southern California Edison, they use air-blast



POWER ENGINEERING IS BIG BUSINESS WITH OUR AIR FORCE

IMPORTANCE OF POWER IN U. S. DEFENSE PLANS DEMONSTRATED AT USAF HEAT-POWER CONFERENCE

RECENTLY the United States Air Force conducted a Heat and Power Conference, at Wright-Patterson Air Force Base near Dayton, Ohio. This was sponsored by the Director of Civil Engineering, Headquarters, USAF.

Ever-increasing demands for power in the military require constant planning and updating of power facilities at all installations. The Air Force happens to be one branch of the military which has a greater need for increased power than other divisions. Consequently, their power engineers are constantly seeking ways to increase efficiency, reduce operating expenses, and get more for their power dollar.

Despite an increasing weapons load, budgets for maintenance and operation have not increased in proportion to the amount of equipment and facilities to be served by the Air Force. This has led to the development of an excellent program on conservation in heat and power.

A few simple statistics would be of interest, to show the general magnitude of the problems facing this group of engineers. In round figures, the Air Force has the following electrical generating facilities: Steam — 110,000 kw; Diesel — 457,000 kw; Diesel Standby — 455,000 kw; or a total generating capacity of 1,500,000 kw. This is big business!

As to energy consumption, it is estimated that in fiscal year 1960, the Air Force will purchase some 5 billion kwh, and generate about 2 billion; or a total utilization of approximately 7 billion kwh of electrical energy.

Heading up the Construction and Power facilities for the Air Force is Maj. General A. M. Minton, a dedicated power engineer. He has long been a strong advocate of conservation of utilities, better training programs, elevation of his engineers (professionally), and a completely modern type of thinking in his Division.

Importance of this Conference is attested by the high level of persons attending the meeting. Representatives of the Department of Defense; Office of the Secretary of the Air Force; Headquarters, USAF; representatives of foreign governments; Department of the Army; Department of the Navy; and all major commands of the Air Force were in attendance.

Two divisions of the Air Force are concerned with the problems of facilities; namely, Engineering and Maintenance. Both departments were represented; however, this Conference dealt entirely with maintenance and operation, and did not concern itself with design or engineering, particularly.

Colonel Henry J. Stehling heads up the Headquarters Maintenance branch of the Air Force. On Col. Stehling's staff, Lt. Col. A. L. Pierce heads Maintenance of Utilities. He is complemented by a very high-caliber staff of civilians, several of whom are well known to industry. Lt. Col. Charles W. Sampson represented the Engineering side of the family.

A carefully planned, and well-rounded, agenda was prepared for this Conference. After a greeting from Maj. Gen. F. A. Bogart, who represented the Commander of Air Materiel Command, Maj. Gen. A. M. Minton offered the opening remarks, and stated his aim and objectives in the Air Force maintenance and operating branches. The Conference got into full swing with a short talk by Mr. George Grimm, of the Office of Secretary of Defense. George Grimm is one of the top power engineers in the country, and well known in private industry utility circles. He discussed Purchased vs Generated power. Speaking for the Military in general, he gave some very staggering figures — which are most impressive. He pointed out that the Department of Defense has been spending about $1.6 billion for construction, and $2.0 billion for maintenance and operation. The relation between these two figures is certainly thought-provoking.

Mr. I. C. Jeffrey, of Col. Stehling's staff, gave a most interesting talk on the subject of "Where We Are and What Needs to be Done." He furnished some of the statistics quoted earlier, and stated some of the objectives of his branch. He pointed out that greater training must be provided for their utility operators, especially in the nuclear plant field. He mentioned the diesel-training school at Sheppard Air Force Base, which was discussed in more detail later. Mr. Jeffrey also stressed the need for designs of utility equipment, predicated on ease and low cost of operation and maintenance.

Next on the program was Professor Paul Grogan of the University of Wisconsin. Paul is well known to many of our readers and to utility people in general. He gave a most interesting talk on general power plant basics. Scattered throughout his talk was a wealth of good practical information, and an ample sprinkling of the usual Grogan wit.

Following Mr. Grogan, there was an excellent talk by Mr. Leon Williams, from USAF Headquarters, on the subject of "A Practical Approach

to Conservation of Heat and Power." In this talk, Mr. Williams brought out the fact that the Air Force has been spending about $163,000,000 per year on utilities maintenance and operation, alone. He cited a number of examples for comparison, among different commands of the Air Force, and pointed out where improvements could be made.

It was interesting to note the breakdown of their total expenditures. The distribution of these funds is approximately: 3 per cent for sewage disposal, 7 per cent for water plants and distribution, 40 per cent on electrical systems, and 50 per cent for heating. Mr. Williams cited interesting unit-costs for maintenance and operation, and showed that excellent records are being kept — for comparative purposes, between bases.

It was quite significant that the motto for this conference was *Power on the Ground Is As Vital As It Is in the Air*. This, in itself, proves the importance of power to the Air Force, and shows a complete appreciation of this fact.

Since the Air Force operates so many remote bases, *Diesel engines* are very important, and one of the common working-tools of this branch of the Military. To obtain well-trained operators, the Air Force has set up its own Diesel-Training school, at Sheppard Air Force Base. Captain Henry Poos, from that location, gave a most interesting description of their training facilities.

He described, in complete detail, a Diesel-Training Simulator which they have developed. With this equipment, the instructor can set up hypothetical cases of trouble which could be experienced in the engine. Then, from a regular instrument board, the students are trained to recognize faults, and how to correct them, from instrumentation, alone. This is recognized by the diesel-engine industry as being one of the most unique and effective methods of training yet developed.

Also on the subject of Training, in general, Maj. Harold Curley described how the Air Force has been organized for training of its people. A good description was given of the methods employed at three organizational levels; namely, Engineer Officers, Foremen, and Operators. This talk proved most conclusively that the Air Force knows what it is doing. (Industry could learn a lot from the systems they have developed.)

Following the above talks on Training, there was a panel discussion on the subject, which was most enlightening. This panel included some of the best experts in this field. Lt. Col. Shay, of the Air Force Training Division, sat on the panel, as well as others who were highly qualified to comment on the questions raised by the audience.

Next in line, and of great importance, were a number of sessions on Diesels. First, Mr. George Clary, of USAF Headquarters, gave an excellent talk on *Diesel Design Criteria*. He explained some of the basic fundamentals which had been developed for diesel design. He pointed out that diesels used by the Air Force were limited to electrical loads under 10,000 kw. They are divided into three classes: Class A is for continuous-duty, and normally is for a plant containing three to six units; Class B is for medium duty and/or standby; Class C is for light duty and intermittent service.

Mr. Clary explained that speed, in itself, is not a good criteria in selection of diesels. He did state, however, that this factor must be considered in the establishment of all standards. (Obviously, from the great number of diesels in service in the Air Force, and with their facilities for collecting operating data, this division of the Military is highly qualified to establish design criteria.)

Mr. Richard Osborn, of the Air Defense Command, gave a most interesting talk on problems encountered in *Operation of Air Force Diesel-Electric Generators*. He stated that the Air Force operates over 1800 diesels, in 473 locations, throughout the globe — and that these units range in size from 20 to 8400 kw. He described some of the unusual operating and maintenance problems at isolated bases.

These problems are not normally encountered by private industry, because of the obvious distance from a source of supply. Some of the more interesting problems are these: Difficulty of obtaining repair parts; wide diversity of manufacturer; extra-critical requirements for continuity of service; lack of trained operators, and ability to hold them on the remote bases; and miscellaneous maintenance problems which have plagued them at some of these bases.

An excellent talk on the recommended Practices for Operation and Maintenance for Diesel Electric Generators was given by Mr. W. T. Malone, Service Engineer of Cooper-Bessemer Co. He praised the diesel-training course which had been set up at Sheppard Air Force Base.

In Mr. Malone's opinion, operators could be trained very quickly in this school. He believes that, contrary to general opinion, many years of experience on the job are not required to make good operators. The general qualifications for a good operation and maintenance setup are these, according to Mr. Malone: Cleanliness and good housekeeping, clean strainers, elimination of water in the fuel; clean air filters; use of Manometers to check air flow; first-

Fig. 1. Col. Henry J. Stehling, chief of Base Mtce. Div. (USAF), is responsible for supervision of maintenance, operation of all Air Force power facilities

Fig. 2 (l to r). Maj. Gen. A. M. Minton (Dir. Civil Engineering), J. J. B. Rockefeller (Office, Secy. of Defense), Maj. Gen. F. A. Bogart (Dir. of Supply, AMC)

class oil filtration; use of centrifuges for cleaning of heavy oils; proper heating of heavy oils; use of lighter oil for starting and stopping; and, most importantly, adequate instrumentation.

Mr. Malone commented on the advisability of tearing down complete units for routine overhaul. He felt, like other experts, that with proper instrumentation, troubles could be spotted long before they become a serious menace.

Continuing with his suggestions for operation and maintenance, Mr. Malone offered some additional ideas. Great care, he said, should be used in cleaning fuel-injection nozzles; he pointed out that misuse of tools for this purpose could be very injurious to the nozzles. He strongly recommended the use of proper *solvents*, only.

Also, he pointed out that the *timing* should be checked frequently — to note any wear in camshafts, chains and gears. Mr. Malone stressed the fact that pyrometers, alone, should not be used for checking the newer-type engines. Again, he stressed the use of *proper instrumentation* for all operation and maintenance. Finally, he said that one of the greatest pieces of advice he could give to operators would be: "Don't tamper with fuel nozzles, unless absolutely necessary."

Following the excellent talks on diesels, a very lively panel session ensued. On this panel were E. G. Huber, George Clary, and R. Osborn, of the Air Force. Also, W. T. Malone (of Cooper-Bessemer Co), Dr. Rice (of the University of North Carolina), and Mr. Davis (of the University of Illinois). Both Dr. Rice and Mr. Davis are consultants to the Air Force.

In this diesel panel discussion, great stress was again laid on instrumentation. It was the consensus that the installation, and proper use of, instruments could provide excellent operation from diesels. The subject of teardown (for routine overhauls) was discussed, and it was generally conceded that this could be more harmful than beneficial — unless proper diagnosis had been made in advance.

Dr. Rice said that, in his opinion, engines could be damaged by *too much* routine maintenance. Mr. Joseph H. Newton (of White Diesel) gave his opinion on the matter of overhaul teardowns. He stated that his company had been recommending the use of proper instrumentation rather than actual teardowns.

The panel group felt that *guide-lines* are needed by users of diesels. A move will be started immediately, to get these guide-lines established, by the Diesel Engine Manufacturers Association. One general thought emerged from this panel discussion; this is that there is a positive need for more adequate instrumentation on all diesels, to reduce maintenance and improve operating efficiency. All in all, the panel discussion was most enlightening and educational.

In the distribution of electrical energy, the Air Force operates many miles of lines on its bases. Therefore, it is greatly concerned with problems of operation of all of these systems. Mr. Fred W. Remp, of Cincinnati Gas & Electric Co, gave a most excellent paper on the procedures used by his company for maintaining their system. He started with the safety measures employed, and showed equipment and procedures used in this particular field.

Then, Mr. Remp described their methods for testing of transformers, maintenance and testing of circuit-breakers, voltage-regulators, high-tension switches, relays, generators, and distribution system in general. He gave an interesting comment or two on their methods for checking wood poles, and on load-balancing on their substations. It was a most excellent and comprehensive talk and of great interest to all.

As stated earlier, much of the electrical energy used by the Air Force on its bases is purchased from outside utilities. Mr. R. C. Hand, of USAF Headquarters, discussed the matter of Electric Utility contracts. He pointed out that some $65 millions had been spent in the fiscal year of 1959 for purchased gas and electricity. He then gave a detailed account of how the Air Force negotiates with outside utilities, to obtain the best possible rates and service for their bases.

Conference then turned to Heating Systems for Air Force bases. Mr. Raymond Felix, of USAF Headquarters, gave a very nice talk on how the Air Force had progressed in its over-all design and operation of heating plants. Some years ago, he stated, these systems had been poorly designed, and required lots of manpower, training, and maintenance. This was because there were so many individual heating plants scattered throughout the bases. Later, they went to automatic plants, with safety devices, and larger central systems, in all possible cases.

Relating heating costs (from all types of fuel) to a common denominator, Mr. Felix pointed out how the Air Force had, in recent years, reduced its unit-heating-cost immensely. He pointed out that hot-water heating systems are favored; and, where distances warrant the expense, the use of high-temperature hot-water systems.

It was pointed out by Mr. Felix that the high-temperature hot-water systems give a considerable savings over steam; also that good efficiency is obtained over a wide range of the capacity of the plant. Other advantages were cited, and all pointed most favorably to the use of the HTHW type of system.

Most interesting is the fact that the Air Force is making great strides in the utilization of *waste heat from diesel plants*, for space-heating. The plants along the Dew Line and the Sage Line are using this system extensively. (POWER ENGINEERING will be carrying specific articles on this subject later in the year.)

On the subject of Corrosion Control and Boiler Water Treatment, Dr. A. A. Berk (of the Bureau of Mines) gave a most practical and comprehensive talk.

Theme of his discussion was "Boiler Water Conditioning Is Fuel Econ-

omy." Dr. Berk explained that the Bureau of Mines is not competing with private water-consulting firms, but is bound by law to provide consultation on boiler feedwater treatment to all Federal agencies that request this service.

Certain basic fundamentals were disclosed in this talk, and were then discussed at some length. Basically, corrosion control consists of alkalinity control and dissolved-oxygen removal. Next, heating plants, when operated according to good practice, will stay in good physical shape indefinitely. Then, the fact was brought out that most corrosion in boilers is due to poor lay-up practice, when the boiler is out of service.

A description of a caustic-embrittlement detector, which was developed by the Bureau of Mines, was described by Dr. Berk. (Note: This was covered in the April, 1960 issue of POWER ENGINEERING, p. 68.) Carbonic acid is the most damaging element in return-line corrosion, according to Dr. Berk. This is generally removed by efficient operation of deaerators.

Dr. Berk gave some excellent hints on how to run condensate surveys, in the average Air Force heating plant. Certain rules of operation were noted in this talk. They were: 1. Minimize the quantity of make-up water; 2. use sodium hydroxide in treatment; 3. maintain deaerators in good condition; 4. split system softeners are ideal but require skilled operators; 5. use morpholine and psychozyline to control return-line corrosion.

Convincing proof of Dr. Berk's philosophy is noted in the fact that on a survey (of some 15,000 boilers) which the Bureau of Mines made for the Air Force, the cost of corrosion damage — prior to the survey — was $2.5 million a year. After the Bureau of Mines control systems had been initiated on all of these boilers, the corrosion-damage cost had dropped to $1 million a year. This certainly is a positive demonstration of the value of adequate water treatment in heating plants.

Next on the agenda was the subject of Instrumentation and Controls, as they apply to heating and power plants. Mr. Russell Attridge, of Minneapolis-Honeywell, explained what instrumentation and controls can do, in the way of providing greater economy — through increased efficiency and reduced operating and maintenance costs. Mr. Attridge reviewed the extent of instrumentation now in use by the Air Force, depending on the size and complexity of the boiler plant. He pointed out that they are now making excellent use of such instruments as CO_2 meters and flowmeters, draft-gages, temperature-indicators, low-water and high-pressure cutoffs and electronic combustion programming equipment.

He mentioned the latest developments in flame-detection equipment, which is more reliable than equipment designed and built some years ago. Then, he spoke of the control of temperatures in buildings; this is generally applied as both a control and a conservation measure.

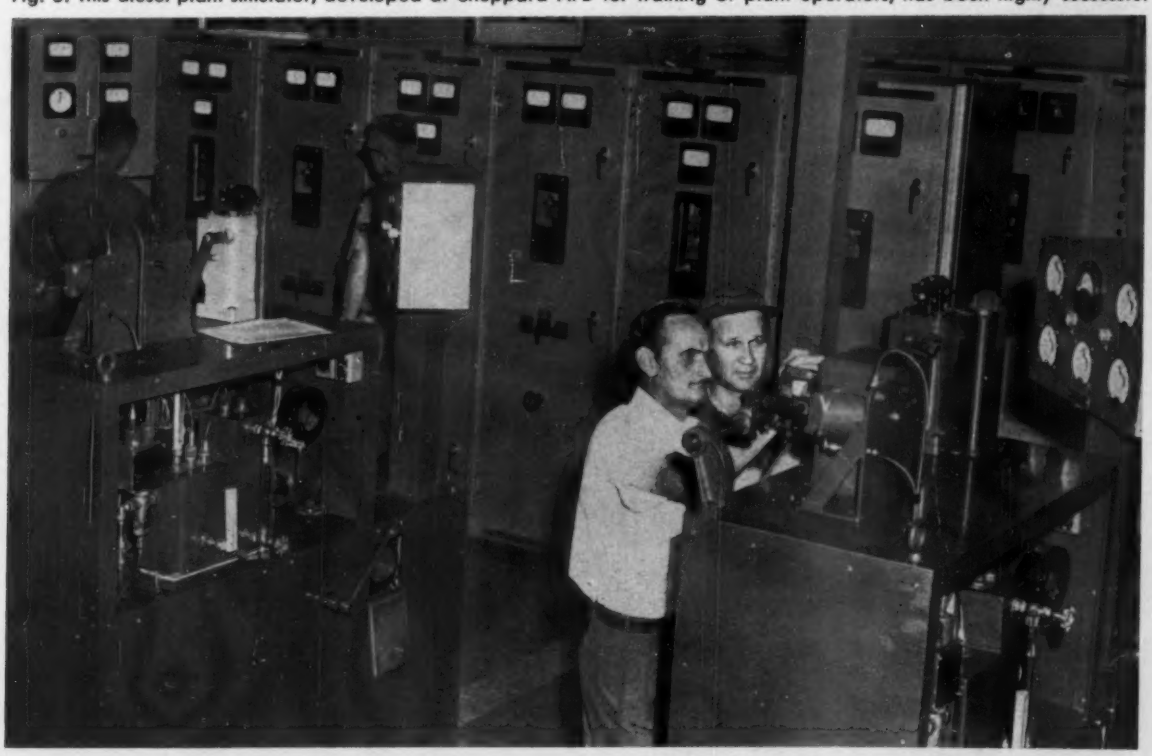
As a labor-saving device, Mr. Attridge explained a new system known as a Surveillance Alarm System. This equipment will detect a failure in any of the control systems in the power plant, and automatically transmit it to a central control-point. System is connected to the safety devices on the boiler, and transmits an alarm signal to any designated point. Then a serviceman can be dispatched, to prevent costly and dangerous breakdowns, or to restore the boiler to service. This function is performed over a two-wire telephone system between the boiler plant and maintenance headquarters. It was pointed out that this system has now been installed at a number of Air Force bases.

In summary, Mr. Attridge's talk was a well-rounded discussion of instrumentation and controls as they apply to the Military, as well as to industry. The examples cited are good evidence of the cost reduction which can be obtained through proper use of instruments and controls.

Mr. Maynard A. Rausch, of Head-

Continued on page 94

Fig. 3. This diesel plant simulator, developed at Sheppard AFB for training of plant operators, has been highly successful



Power Engineering

TIME-TESTED TECHNIQUES IN ALUMINUM CONDUCTOR CONNECTIONS

MEAD WARREN, JR., OF ALCOA, CLEARS UP QUESTIONS ABOUT HOW TO MAKE ELECTRICAL JOINTS INVOLVING ALUMINUM, IN BOLTED, COMPRESSION OR WELDED CONNECTIONS

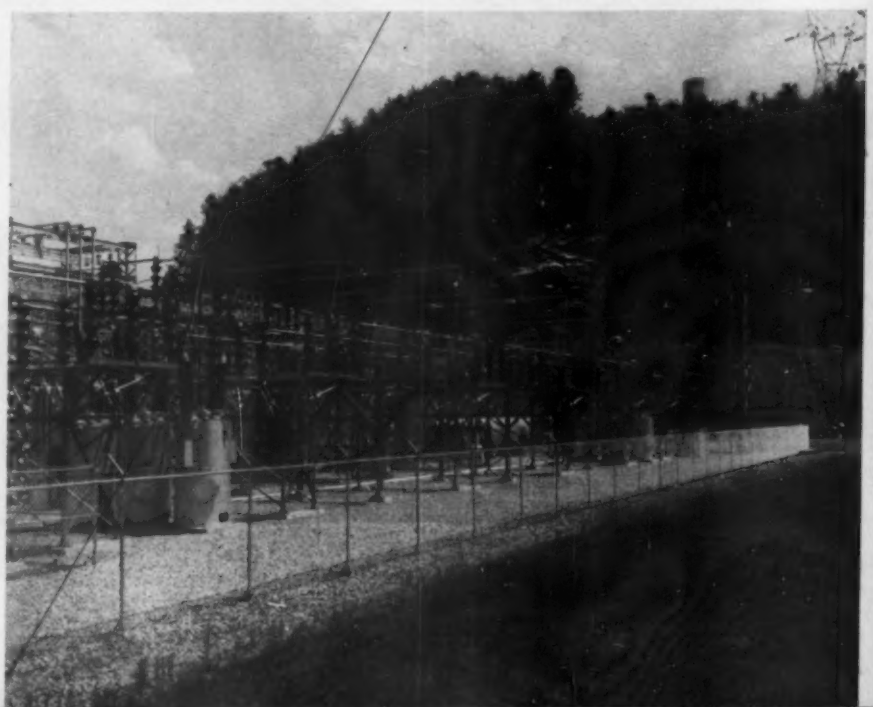
FOR MANY YEARS aluminum has been almost universally accepted for electrical conductors on high voltage transmission lines. In more recent years it has also become more widely accepted in lower voltage distribution circuits. Lately, electric power operating people have recognized the merits of using aluminum in substations for both conductors and structures.

Figure 1 shows a typical all-aluminum substation, including structures. Various shapes of aluminum conductor were used. This included stranded, tubular, and rectangular bus conductors. Practically all connections were welded except those made to equipment. Figures 2–5 show typical high and low tension connections.

Acceptance of aluminum in substations raised questions of making connections of aluminum to aluminum and aluminum to other metals. While such connections have been made successfully for many years and, in fact, some have been in continuous operation in outdoor service for nearly half a century, there still exists a considerable amount of misunderstanding, confusion, and mystery regarding making satisfactory connections. Many technical articles have been written over the past decade on the subject of making satisfactory connections with aluminum, some even stressing the need for expensive plating of contact surfaces. However, the need was not very prevalent and consequently the articles did not receive wide attention. Furthermore, many of these articles were written more from the technical viewpoint rather than from the viewpoint of practical application and thus have not been of ready reference to the construction and operating people.

Fundamentally, the factors in making a good electrical connection with aluminum are no different than

Fig. 1. Various shapes of aluminum conductor were used in Chilhowee substation



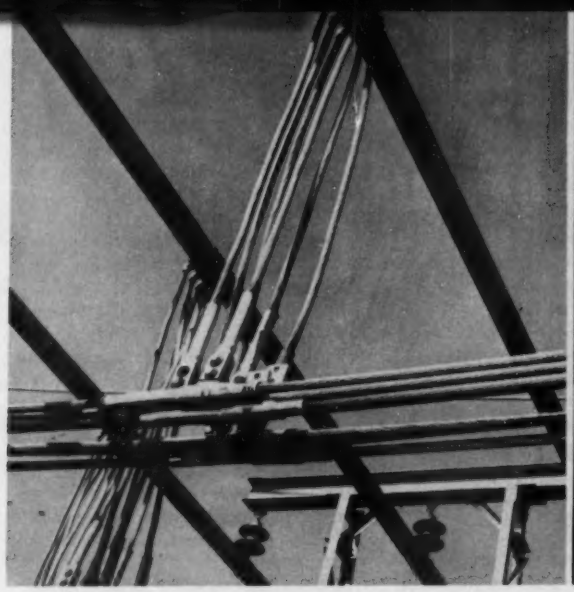


Fig. 2. Typical jumper connections for a 13.8-kv bus system

Fig. 3. Method of making joints in a high-current d-c bus

those of other metal; but the need for observing these factors is more important. Same principles apply whether the connection is aluminum to aluminum or aluminum to other metals. Failure to observe a few basic principles may result in a more rapid and extensive deterioration of the joint.

In making an electrical connection with any metal, the basic principles necessary are to make a strong joint mechanically and a good connection electrically and to provide whatever means that are needed to keep it that way. There is usually no problem in making any joint mechanically strong. Initially, there is no more problem in making an aluminum electrical joint than there is with any other metal. Normal requirements in making the joint satisfactory are to see that the surfaces are clean, with a minimum of oxides, and that they are mechanically tight.

The fact which power operating people usually fail to observe is the greater care necessary in maintaining the electrical connections. When aluminum is involved, it must be recognized that the physical, chemical, and mechanical properties are different from those of copper and steel.

For example, the relatively high electrochemical potential of aluminum requires protection from corrosive elements entering the joint and from galvanic action as a result of contact with dissimilar metals in the presence of moisture. Even if dissimilar metals are not involved, moisture should be kept from mechanical joints. Obviously, these problems are the same in varying degrees in all electrical connections. The solutions are very simple and very practical. Only a few very basic rules need be observed:

1. Clean the joining surfaces to remove dirt, oxides, and foreign material.
2. Apply electrical joint compound.
3. Fasten joint securely.

The solution in making a clean joint, of course, is very simple. One must remember only to see that the surfaces are clean, with a minimum of oxides, and that sufficient contact area is provided. For many years the practice for making aluminum joints was to clean the surface and apply some stable, non-soluble grease which would protect the surface from reformation of oxides and prevent water and corrosive materials from entering the joint. Such materials as petrolatum and "no-ox-id" were used. Many joints made this way are in use today and have been carrying full load current successfully for over half a century. In recent years other materials such as Alcoa's No. 2 joint compound have been developed and have superior qualities, principally in reducing the joint resistance.

Second problem of making a good connection is to prevent the entrance of corrosive agents and water into the joint. Third basic rule is to make the joint mechanically strong. Only precaution in this case is to remember that the repeated heating and cooling

Fig. 4. View of 6.9-kv connections to main power transformer

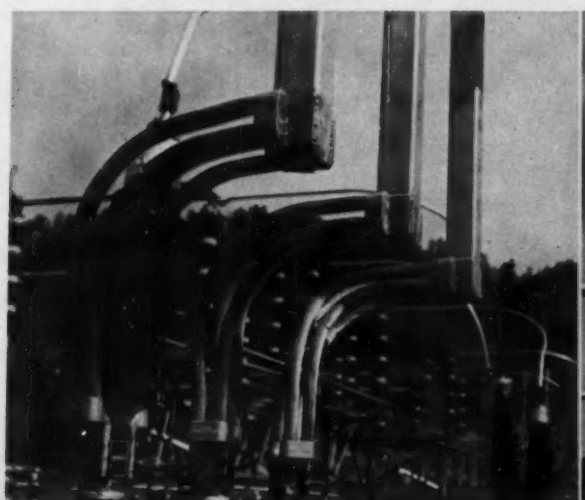
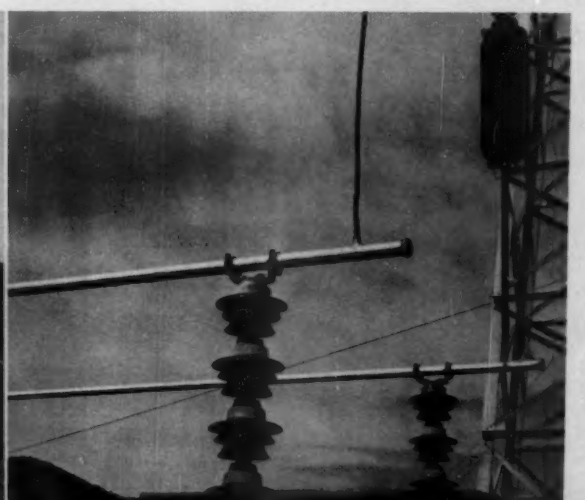


Fig. 5. This is transmission line connection to 161-kv bus



of the joint, because of the load cycling, may cause expansion and contraction of the metals which will eventually loosen the joint; therefore, a good heavy-bodied connector is always to be desired.

Such is illustrated in Fig. 2, which shows typical jumper connections of a high capacity 13.8-kv bus system. Connections are between stranded aluminum conductor and channel aluminum bus. The channel bus has the unique design feature of being mounted by suspension insulators. Such arrangement greatly reduces the insulator strain during fault conditions. The channel aluminum bus was fabricated by welding two channels together with spacers.

All of the basic rules discussed above apply to bolted connections. In conditions where temperature variations may be great because of high current densities or other reasons, some precaution should be taken to guard against differential expansion between the conductor material and the bolts. In most instances, aluminum bolts should also be used to avoid this difference in expansion, although in some connections, steel bolts or Everdur bolts have proved satisfactory. In multiple-layer joints, as where several layers of flat bus are used, or where for special reasons a high joint pressure is desired, steel bolts are frequently used. In such cases, Belleville spring washers are necessary to provide for the difference in expansion and to maintain contact pressure.

Figure 3 shows methods of making joints in a high-current d-c bus. Lower bus consists of 22 pieces of ½-in. by 10-in. aluminum bus connected to the smaller buses above. Belleville washers were inserted between the bus and clamping yoke in order to maintain uniform pressure with varying temperatures. Connections on the upper buses were made with Belleville washers under the nuts. Evidence of joint compound can still be seen after 25 years of continuous full-load operation.

Compression connections, since the early use of aluminum, have proved successful. Here again, before the connection is made, the joints should be free of dirt and oxides, and some stable, non-soluble material should be used so that after compression all openings in the joint will be sealed against the entrance of contaminating materials and water. For many years red lead (zinc chromate) was used very successfully. Alcoa filler compound is used today in place of zinc chromate for ACSR cable joints which will be under tension, since it does the same job and is cleaner.

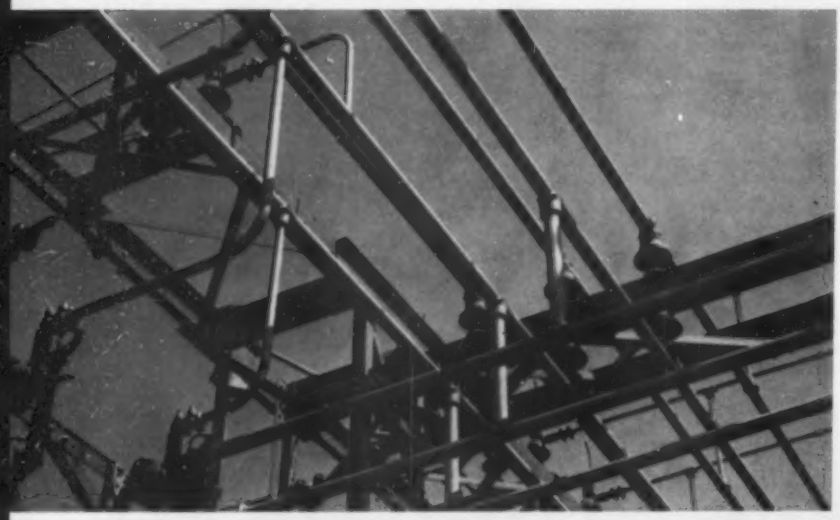
For those joints not under tension, Alcoa No. 2 joint compound is equally satisfactory for sealing the joint and reducing resistance.

Welded Connections

Welded connections have become much more popular in the last few years, particularly in substation applications, because of innovations in welding techniques. Inert-gas arc welding can be done very simply and requires little special skill. Furthermore, the joint is very neat in appearance and requires no cleaning or filing. Inert-gas arc welders, such as the argon welders, have been developed to the extent that they are now very practical field tools.

Techniques for making welded joints between aluminum and other metals are rapidly being developed, and many applications have already been put into commercial practice.

Figure 8 shows an all-aluminum distribution substation of the City of Maryville, Tenn. This is typical of a small substation with aluminum structure and conductors. Figure 6 shows the use of welded tubular aluminum bus in this station. Connections to equipment are made by bolting aluminum directly to copper terminals. Figure 7 shows a typical outdoor aluminum control cable connection to a terminal block. It is mounted in an aluminum test box with sliding lid. No particular care is necessary in protecting this from moisture. THE END



Figs. 6 (left) and 7 show details of all-aluminum substation in Maryville, Tenn. (Fig. 8): welded tubular bus, and typical outdoor control cable connection

MAXIMUM SAFETY WITH AVAILABILITY PROVIDED BY REMOTE MANUAL FIRING

E. M. MICHALSKI OF COMBUSTION ENGINEERING AND
R. A. NEAL OF SOUTHWESTERN ELECTRIC BRIEF THE RECORD
ON THIS MAJOR ADVANCE IN CONTROL

FUEL FIRING by remote manual control has met with satisfactory acceptance and approval of the operating personnel at Southwestern's Lieberman Power Plant. This system has increased the safety margin of operation through the use of sequential and permissive interlocks. Furthermore, through the utilization of centralized control, the control room operator has additional knowledge of station conditions and is in complete command at all times in controlling the operation of the steam generator to meet changing station conditions.

How It Got Started

Development over the years of remote control technology, and material progress to implement it, gradually indicated that adaptation of the art to all situations was growing more and more possible. A major step forward occurred in 1957 with the installation of a 100,000-kw reheat steam generator in northwestern Louisiana at the Lieberman plant. Everyone interested in the design of the plant and equipment concentrated on maximum safety and availability.

Safety was not to be sacrificed in any way whatsoever. Rather, it was to be made compatible — to walk hand-in-hand with availability — insofar as it was humanly possible. Remote firing as a completely centralized control function coupled with a system of safety interlocks seemed the ideal building block in this design picture.

To develop the system for remote firing, the authors joined forces. With outstanding assistance of operating personnel of Southwestern Electric Power Company and Sargent & Lundy consulting engineers, work was begun with a Human Engineering study. This involved defining the task of the proposed man-system combination, setting up standards and limitations of performance, considering all conceivable operating conditions, and, finally, selecting the equipment and designing the system.

In developing criteria for the proposed system, three salient features emerged: First, it was definitely concluded that decisions concerning firing equipment should always be the province of the boiler operator with the jurisdiction of sequential and permissive interlocks. For instance, flame safeguards were to be provided, but the decision to let the flame detection system trip the fuel to the boiler or merely to sound the appropriate alarms remained under human control. Secondly, it was clearly indicated in the preliminary study that furnace television should be recommended as an imperative adjunct for operation of the remote firing system. And thirdly, it was decided to utilize the unique properties of tangential firing in planning the system.

In a tangentially fired steam generator, burners in each of the four furnace corners fire tangent to an imaginary circle in the center of the furnace. The resultant whirling motion of fuel, air and hot gases thoroughly mixes the ingredients, and the combustion process is supported and promoted throughout the entire furnace plan area. Because of this continuous mixing and burning, the entire furnace is considered as the burner. From this concept arises what is called "total furnace blackout," or total flame failure, protection.

In this approach to furnace safety, individual burners are not tripped one by one as in a front fired furnace. Rather, the flame detectors at each corner (burner) must all signal flame failure before action is initiated, and then a total fuel trip (cutoff) is used. Flame failure signals from individual corners are usually used for alarm only when this protection principle is employed.

With these design criteria established, planning proceeded for the gas firing system.

Defining System Functions

The basic task assigned to the proposed control system was to provide firing operations from a centralized point in such a way as to promote maximum availability of the steam generator while enhancing operating safety. The system was designed to:

1. Provide facilities for operating a purge of furnace and boiler from the control room, and prevent subsequent operations until purge had been completed.

2. Furnish controls for lighting side ignitors from control room. Indication of ignitor functioning to be transmitted to the central panel, and side ignitor flame to be proved before fuel could be admitted to adjacent main burner nozzles.

3. Permit placing main gas guns in service from the central control panel by controlling fuel admission and adjusting air dampers.

4. Continuously monitor main burners and, either signal flame failure by alarm, or provide a fuel trip *and* alarm on loss of flame signal in all four corners.

5. Furnish protection against low gas supply pressure by preventing

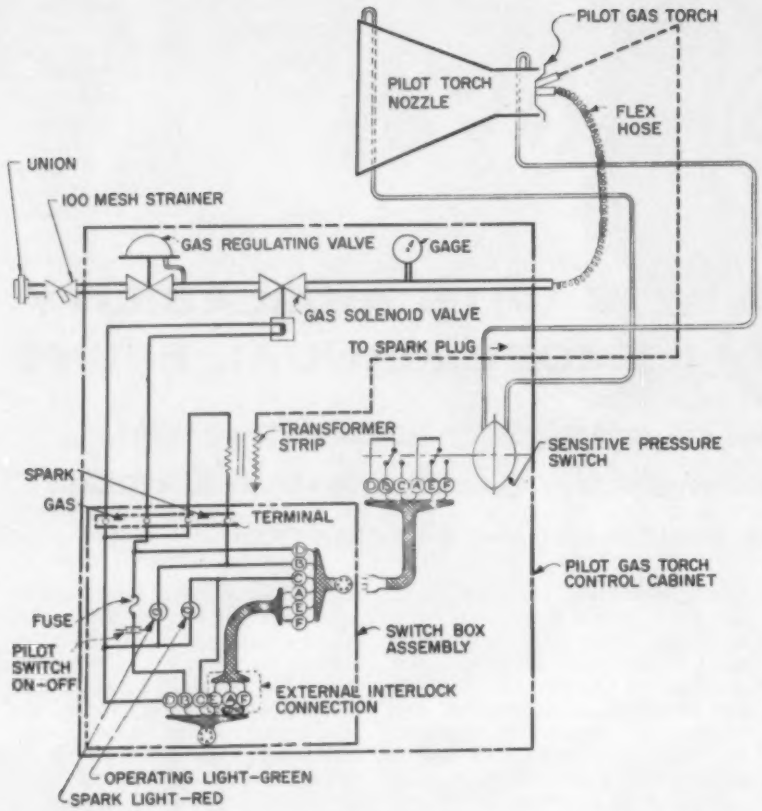


Fig. 1. Diagram shows application of pressure-sensitive switch for flame detection

start unless proper pressure is available, or by initiating total fuel trip in the event of abnormally low gas supply pressure.

6. Provide auxiliary gas control valve to pass minimum safe flow requirement in event of main control valve malfunction.

7. Provide protection against fan failure by initiating total fuel trip on failure of both F-D fans

8. Provide operator with continuous visual flame check by television.

9. Furnish at control panel information on the state of components by indication or alarms.

10. Allow the operator to have maximum freedom of decision within limitations of mandatory sequencing requirements and permissive interlocks.

Defining Operating Conditions

We agreed that our primary decision to leave the "operate" in "operation" (*i.e.* not trying to automate all decision-making functions) would create some important advantages. Having the operator in the position of command, we could limit the use of interlocks to those we felt were absolutely essential. Interlocks would not be used in those conditions where a properly trained operator could be expected to take corrective action.

Low gas pressure and fan failure were to be used to trip the boiler because in these areas we might expect unusual hazards. Sudden loss of gas pressure with subsequent regain might occur before an operator could reasonably be expected to react. The nature of his reaction could vary with the time aspect of the trouble and might call for perfect, split-second timing. Loss of both F-D fans in this pressure-fired unit could also make necessary an instantaneous and perfect decision.

With these two possibilities we decided to trip fuel on failure of the governed variable. We did not feel that we had made a decision in favor of safety at the expense of availability, although such a decision may be essential in some cases. Rather we felt we were deciding in favor of *long range* availability. Over a reasonable period of time, the loss in availability from total fan outage or loss of gas supply pressure could be expected to be insignificant.

These emergencies might never arise. But if they did happen, we were faced with a choice between a brief, inexpensive outage, or the possibility of a costly, prolonged outage to repair explosion damage. The ability of the operator to make a perfect split-second decision would make the difference between the two. Here, we decided, the tremendous responsibility placed on the operator was not justified.

Water level, superheat temperature and the like were conditions we could expect the operator to handle in a safe and proper fashion. These conditions, therefore, were not to be governed by interlocks. Power failure, which might cause an inadvertent outage, was covered by supplying half of the burner systems from one 115-v a-c bus, and the remainder from a second and entirely separate bus. Constant-voltage transformers were to be specified to minimize undervoltage dropouts due to system upsets.

Most of the components used had proved *intrinsic* reliability, or dependability, through their use in "fail-safe" systems. For example, if a tube or resistor in a flame safeguard device should fail, the device must cause a fuel trip in order to demonstrate acceptable dependability. Acceptable here refers to the requirements of the insurance underwriters for approval. Thus if a device "fails safe" or causes a fuel trip whenever any of its many internal components fails, we may say that it is perfectly dependable.

But there is a tremendous gulf between dependability of components and reliability of the system. For instance, a component which causes three fuel trips per week through internal failure may be perfectly dependable, but it makes the over-all system appallingly unreliable. In designing a system for availability, it is mandatory that "false" component failures be eliminated or made ineffective.

Building the System

The gas-fired steam generator was equipped with tangential burners shown in Fig. 2. The four burners (one in each corner) contain four fuel and five auxiliary air compartments each. Every fuel compartment was fitted with two gas nozzles, making a total of eight gas nozzles per corner or 32 all told. An electrically ignited gas-fired side ignitor designed for continuous operation was mounted adjacent to each fuel compartment. Four flame safeguard scanners (flame detectors) were mounted, one in each corner, and were sighted downward on the vertical tangent centerline of each burner, as shown in Fig. 3.

For gun operation or shutdown assignment purposes, each fuel compartment (containing two gas noz-

zles) is treated as an individual burner and is furnished with a General Controls hydramotor-type trip valve and a manually operated lubricated plug cock. Thus there are four gas hydramotor valves per corner, making a total of 16 valves for fuel shutoff at the burners. Two main header gas shutoff valves have an automatic vent valve between them. The supply line for the pilot torches originates on the *downstream* side of the main supply trip valves. With this arrangement, all sources of gas admission to the furnace — main burner and pilot — are protected with double shutoffs in the event of a fuel trip.

By experimentation, the auxiliary gas control valve is set to bypass sufficient gas to maintain ignition on all burners under the most extreme air flow conditions. This valve is very helpful in lighting off initial burners and serves a major protective function as well. In event of main control valve failure, the auxiliary valve assures sufficient gas flow to keep all burners lit. In this way we avoid possible trips caused by control valve failure.

Design of the gas burner spud or nozzle is of utmost importance, since a well-designed spud with orifices of the proper size and arrangement ensures stability and efficiency over a wide capacity range. By wide burner-capacity range we mean the ability to operate on automatic control, with good flame stability, all the way from maximum rating down to less than 10 per cent of maximum rating with all burners in service. Good systems cannot be built on shaky components.

Controlling the System

In controlling the system the four lower gas-electric side ignitors (one in each corner) are designated Elevation One, and are operated in unison from a single switch. Elevations Two, Three and Four are controlled in the same manner. A similar procedure is followed in designating main burners. The four lower fuel compartments, each containing two gas nozzles, are designated Elevation One. Opposing burners are operated in unison — thus one switch controls burners A and C on Elevation One and a second switch governs burners B and D of the same elevation.

With tangential firing it is not necessary to light only one burner nozzle at a time. In fact it is more desirable to light two at a time or four at a time, for this precludes protracted operation on one burner nozzle of a given elevation. One

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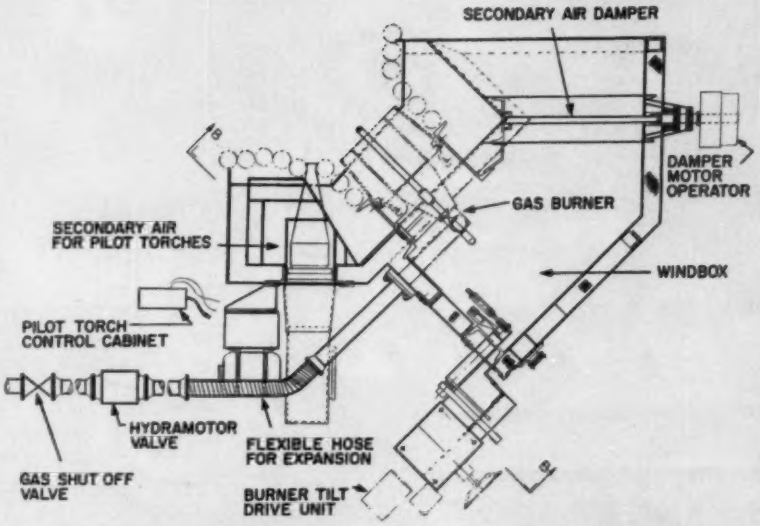
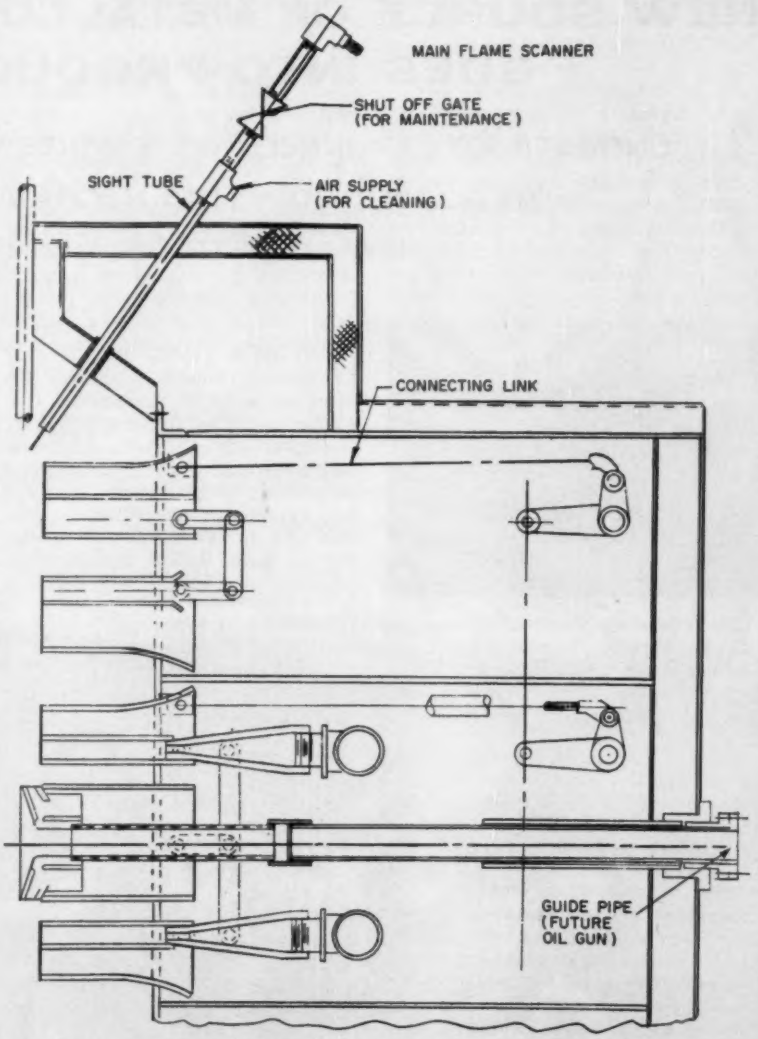
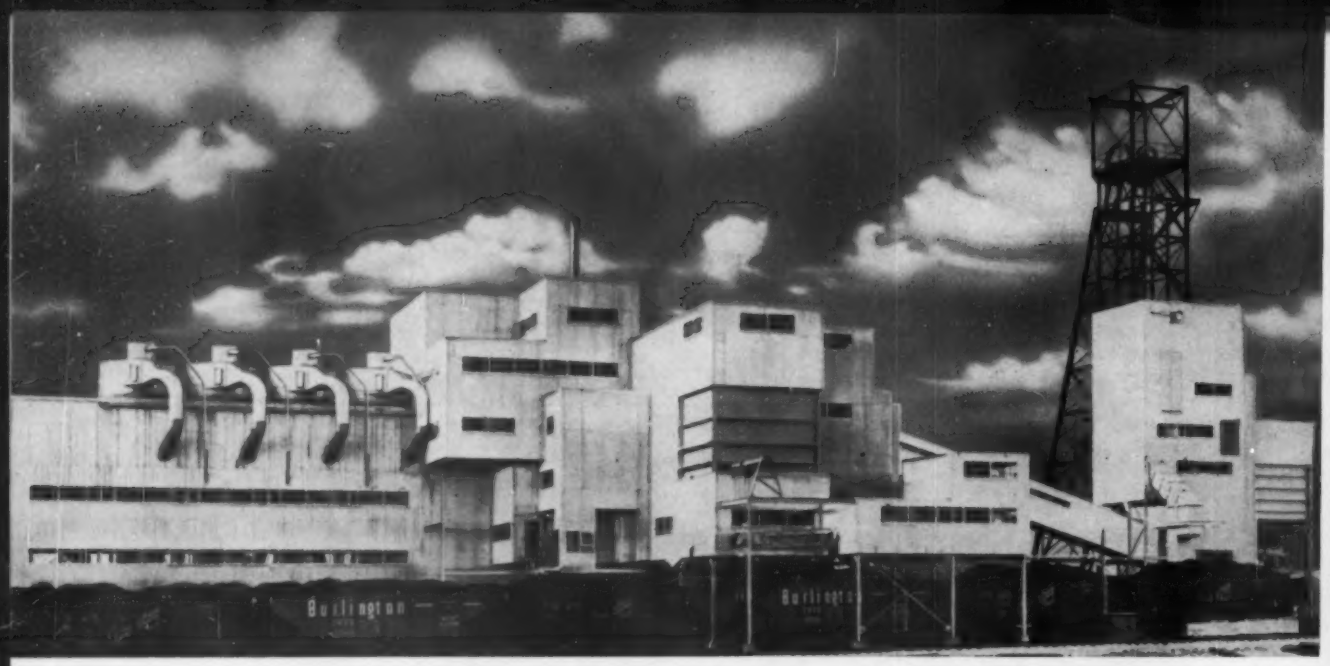


Fig. 2. Plan view of corner showing burner and application of gas side ignitor

Fig. 3. Sectional side view showing installation of the flame safeguard scanner





NEW SOURCE OF METALLURGICAL COAL GOES INTO PRODUCTION

UNOBSTRUCTED TUNNELS WITH WHITE WALLS TOGETHER WITH ALMOST COMPLETE MECHANIZATION GIVE NEW LOOK TO COAL MINING

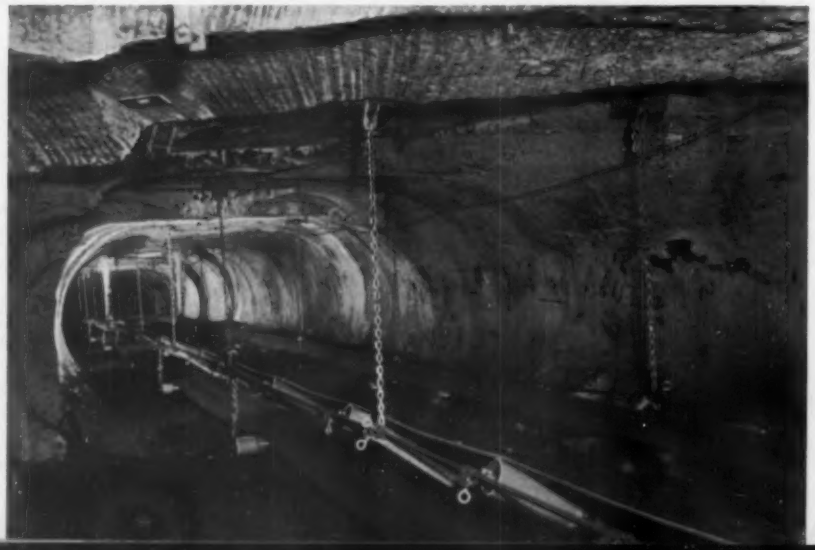
OLD BEN MINE No. 21 near Benton, Illinois, embodies the latest advances in mechanized coal mining, including continuous mining machines, belt conveyors, automatic coal hoists, automatic blending, and remote electronic weighing. The mine taps a reserve of 100 million recoverable tons of low-sulfur coking coal 670 feet below the surface, and is expected to be producing 3 million tons a year by 1962. From the time the coal is bored from the seam until it tumbles into waiting rail cars and trucks, it is handled almost entirely automatically.

Coal from this mine is expected to meet the growing demands of the Midwest's rapidly expanding steel industry. The mine will also provide coal for utilities, factories and domestic users. THE END

TOP. Five-story preparation plant of Mine No. 21 contains the machinery to crush, screen, wash, dry-clean, blend, and load 15,000 tons of coal daily

ABOVE. Control panel in preparation plant permits regulation of all plant operations. Second panel for loading is in a cab over the loading tracks

RIGHT. Goodman roof-suspended ropebelt conveyor is used to transport coal from where the continuous boring machines are at work to bottom of the coal hoist. Coal is stored until lifted to the surface



ISA SHOWS NEW INSTRUMENTATION AT PARLEY IN NEW YORK THIS MONTH

INSTRUMENT SOCIETY OF AMERICA's Fall Instrument-Automation conference and exhibit will be held Sept 26–30 in New York's Coliseum. More than 30,000 visitors are expected. Some 400 leading manufacturers will display the latest designs and advances in the hardware and systems used in various fields. Exhibits will also be staged by the Army, Navy, Air Force and the National Aeronautics and Space Administration.

Speaking at the keynote session on Monday morning, Sept 26, will be: Lieut. Gen. B. A. Schriever, U. S. Air Force Air Research and Development Command, Andrews Field, Md., on Progress Through Instrumentation in the Missile and Space Age; O. W. Manz, executive vice-president, Consolidated Edison Co, on Progress Through Instrumentation in the Power Industry; and E. D. Reeves, vice-president, Humble Oil Refining Co, on Progress Through Instrumentation in the Petroleum Industry.

Others of the some 50 technical sessions scheduled for the conference will feature physical and mechanical measurement instrumentation; data handling and computation; automotive instrumentation; strain gage instrumentation; a computer clinic; a panel on mass flow measurement; feedback control systems. Other sessions will deal with instrumentation in the chemical and petroleum, paper and pulp, electronic, laboratory analysis, nuclear and metals and ceramics fields.

Of keen interest to many fields will be a number of sessions devoted to underwater investigation and instrumentation. Also, three sessions on meteorological instrumentation have been developed jointly by ISA and the American Meteorological Society. These will discuss modern instrumentation in radiation meteorology, stratospheric meteorological measurement and instrumentation for airborne weather reconnaissance systems.

On Tuesday, Sept 27, the conference will hear first-hand accounts of the First Congress of the International Federation of Automatic Control, which was held in Moscow, USSR, June 27–July 2. ISA vice-president Nathan Cohn of Leeds & Northrup Co will preside at this program.

There will be a forum in which engineering societies and technical associations will meet with engineering educators in the exploration of meaningful projects in aid-to-education — particularly in the fast-growing and changing field of instrumentation and automation. This has been named Operation Tip-Toe.

Forum gets its name from The Intersociety Project: Together on Education, and is scheduled for Tuesday, Sept 27, at the Hotel New Yorker. Lloyd Slater, executive director of the Foundation for Instrument Education and Research, will be session chairman.

The long-awaited report of the Task Force on Instrumentation Technicians will be presented on Sept 28 at the Educators' Workshop. This is a report on a two-year survey, made by a committee headed by Abner G. Hathaway, of United Electronics Institute, Louisville. It will include the first public presentation of the definitions for various instrumentation technicians which the task force has formulated.

PORTABLE PUMP RIG SPOTS LEAKING VALVES

PUMP RIG which speeds up hydrostatic testing of valves and other equipment has been built by the maintenance staff at the East St. Louis refinery of Mobil Oil Co. This portable unit is used throughout the refinery, wherever water and air connections are available.

Unit consists of a horizontal air-operated hydro-pneumatic pump with a rated capacity of 7330 psi, which is mounted on a rubber-tired cart. Made by Aldrich Pump Co, this pump supplies hydrostatic pressures ranging from 250 lb to 2500 lb. Operated by plant air at 90 psi, the pump works quietly without vibration, is used mainly at "turn-around" time when refinery units are dismantled, inspected, and restored to optimum working order. Many valves are inspected, rebuilt if necessary, and then tested for leaks under hydrostatic pressure. Relief valves, in addition, are hydrostatically tested for correct operation.

In the valve repair shop, the portable pump is connected to a test stand on which the valves are mounted. Hydrostatic pressures ranging from 125 to 250 psi are then created. This enables the maintenance staff to spot leaks instantly and also adjust relief valve springs to precision settings for specific design pressures.

The portable pump is also used for hydrostatic testing of heat exchangers before they are returned to service. Without disturbing piping arrangements, the unit quickly supplies hydrostatic pressure to meet Mobil's test specifications — such as holding 500 psi for one-half hour.

A major benefit provided by the portable pump is fast operation. Since it is air-operated, pressure is built up to the required level in only seconds.

Simple turn of valve creates hydrostatic test pressures for spotting leaks and recalibration of relief valve springs. Portable rig was built by Mobil Oil maintenance staff at East St. Louis

Fig. 1. Farm Equipment Research & Engineering Center of IH in Hinsdale, Ill. Nearly 1500 people work in the fully air conditioned building containing 455,000 sq ft of floor space

A 4th DIMENSION IN BIG CAPACITY COOLING

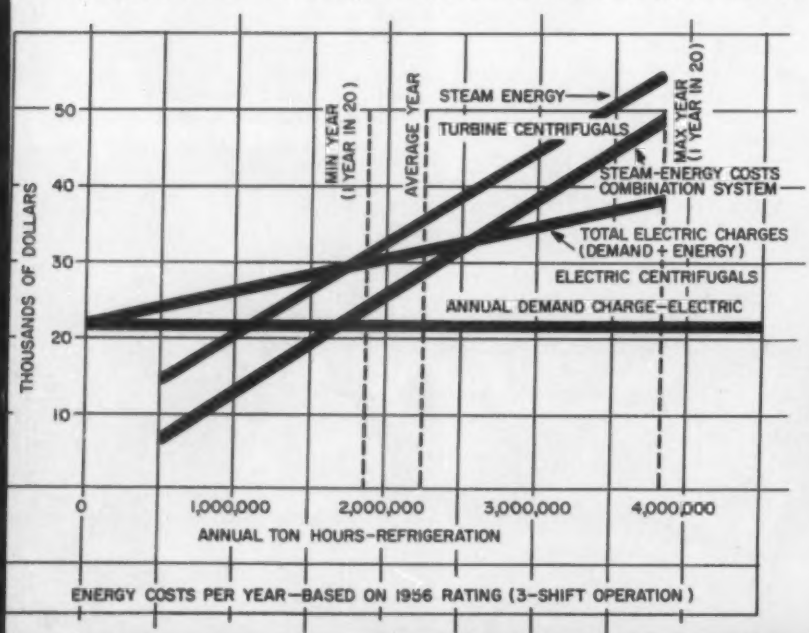
ENGINEER WALTER TREICHLER TELLS HOW COMBINATION-UNIT COOLING PAYS DIVIDENDS FOR INTERNATIONAL HARVESTER

BY COMBINING a steam-activated absorption refrigerating machine with a turbine-driven centrifugal chiller, it is possible to operate a cooling system at greater efficiency than when either apparatus is used alone.

This is the fourth and newest type of large-capacity refrigeration system which should be considered whenever working with several units for large tonnages. The three more common arrangements are heat-operated absorption units, electrically powered centrifugals, and turbine-driven centrifugals.

Called a combination system, this fourth dimension in big refrigeration equipment was installed at International Harvester Company's new Farm Equipment Research and Engineering Center at Hinsdale, Ill.* Located on approximately one square mile of land near Chicago, the modern one-and-two-story building contains facilities ranging from a blacksmith shop to an electronics laboratory, and from a motor test cell to a conference room. Inside the 455,000-square foot structure nearly 1500 people design, fabricate, and test new farm machinery and allied products.

Fig. 2. Chart shows that analysis indicated the combination system was best



To determine which refrigeration system would best serve the Center's needs, an engineering analysis was made. Based on a required cooling capacity of 2100 tons for the technical headquarters, the study evaluated each of the four applicable refrigeration systems on such factors as initial cost, space required, operating economy (both full and part load), and ease of control. The results were as follow:

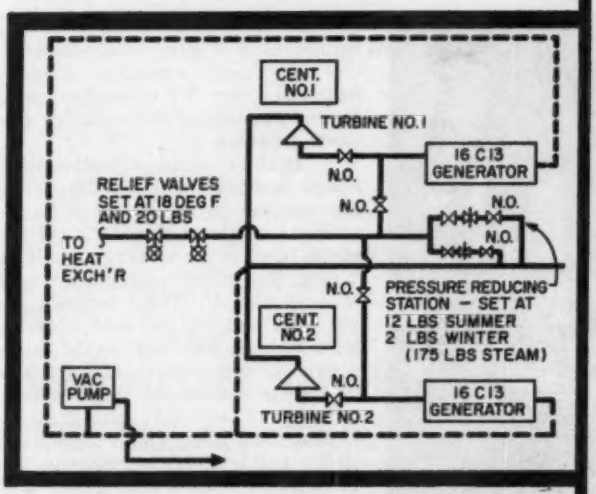
1. First Cost — All systems were within 10 per cent of one another, exclusive of auxiliary equipment.

2. Space — All systems required approximately the same area.

3. Operating Cost — The combination system was least expensive followed by the electrical centrifugal, the turbine centrifugal, and the absorption unit.

4. Ease of Control — The electric centrifugal, the turbine centrifugal, and the absorption machine were about the same while the combina-

* Other combination systems using Carrier equipment are operating at the Socony Mobil Building, N.Y.C.; 425 Park Avenue Building, N.Y.C.; and Hillsdale Shopping Center, San Mateo, Calif.


CENT. NO.1
TURBINE NO.1
16 C 13 GENERATOR
RELIEF VALVES SET AT 18 DEG F AND 20 LBS
TO HEAT EXCH'R
N.O.
PRESSURE REDUCING STATION – SET AT 12 LBS SUMMER 2 LBS WINTER (175 LBS STEAM)
CENT. NO.2
VAC PUMP
TURBINE NO.2
16 C 13 GENERATOR

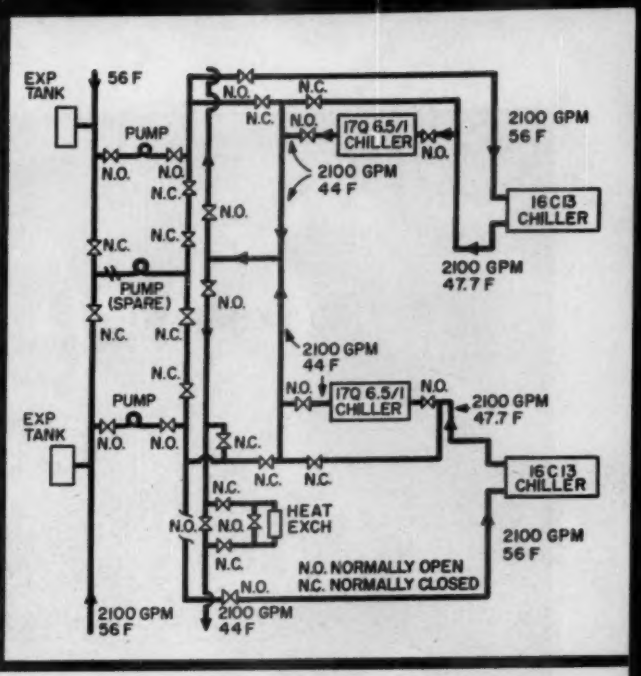


Fig. 3 (above). Schematic of steam and condensate circuit at the IH Plant. Fig. 4. Schematic of the chilled-water circuit. See text for a complete explanation of operations

tion system was slightly more complex.

The analysis indicated the combination system was best for this installation because it was the most economical to operate, Fig. 2. The fact that it was somewhat more complicated to control than a system using either absorption or electric centrifugal was not considered a handicap. International Harvester's Research and Engineering Center, like most major buildings, has a team of operating engineers who are responsible for the operation, control, and maintenance of plant utilities. To minimize problems arising from use of this slightly different system, Carrier Corp, which supplied refrigerating machines, instructed IH engineers in details with which they were not familiar.

The water-chilling plant consists of two Carrier absorption machines (700 tons capacity each) and two Carrier open-type centrifugal machines (350 tons capacity each), powered by two Elliott single-stage back-pressure turbines. Each absorption chiller is paired with a turbine-driven centrifugal.

Two More Economical Than One

To some it may seem impossible to operate two types of apparatus in series and have their combined steam rate lower than if they operated independently, but such is the case. The reason is that the steam is used twice.

The full-load steam rate required by the turbines in the combination system is 40.5 lb per hr per ton of refrigeration. However, the turbine-driven centrifugals provide only one-third of the total cooling capacity. The absorption machines supply the remaining two-thirds of the chilled water while performing the function of steam condensers. This is the key to the low steam rate. By teaming the less efficient single-stage back-pressure turbines with absorption machines, a low full-load steam rate of 13.5 lb per hr per ton of refrigeration is obtained.

The normal full-load steam rate for absorption machines operating independently on 12-lb steam is 19.8 lb of steam per hr per ton of refrigeration. For turbine-driven centrifugals alone using 175-lb steam in multi-stage condensing-type turbines, the steam rate is 16 lb per hr per ton of refrigeration.

How Steam Is Used

Here is how steam is used as the energy source by the combination system, Fig. 3. High-pressure steam at 175 psig is first put through the turbines. The leaving pressure of the steam depends entirely upon the demand for chilled water and the proportion of the total load carried by the centrifugal. At full capacity, the back-pressure should be approximately 12 psig. This pressure will decrease at lighter loads to about two psig. The minimum pressure of the steam will be determined by the regulating steam valve. Should pressures below the set point occur in the line feeding the absorption machine,

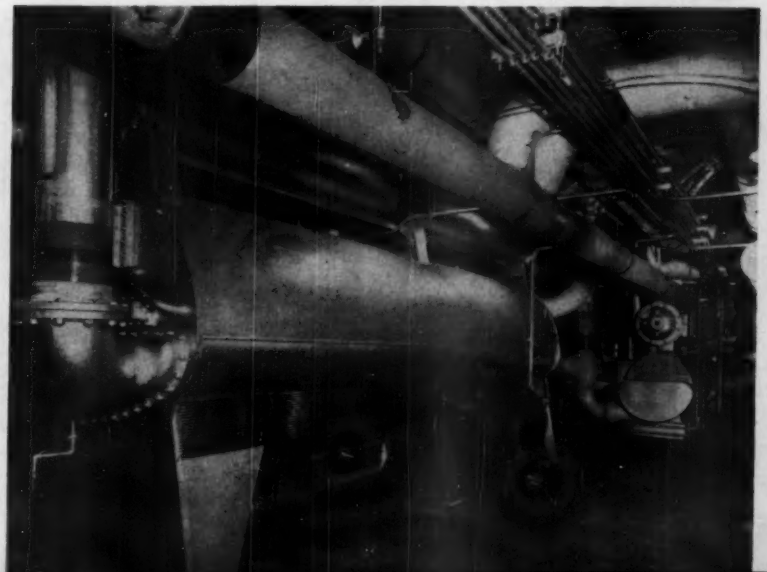


Fig. 5. Carrier absorption machine at left in photo has 700 tons capacity. Carrier centrifugal at right has capacity of 350 tons. This system has a total cooling capacity of 2100 tons

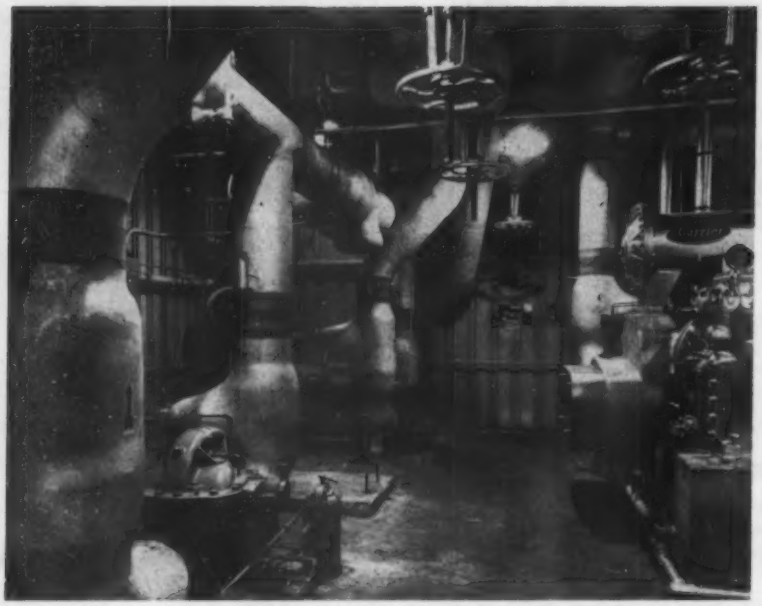


Fig. 6. View of machine room shows the chilled-water piping, pumps, and the end of one of the two centrifugal refrigeration machines having 350 tons capacity

the valve will release additional steam into the line. All steam is condensed in the absorption machine, and the hot condensate drains to a vacuum pump which returns it to the boilers.

Water Circuit Interchangeable

Normally, each combination of machines has its own chilled-water circuit. This system has greater flexibility built into its piping network and permits each pair of machines to operate independently or jointly on the common load, Fig. 4.

Water returning from built-up air-handling apparatus passes first through the absorption machines, where it is cooled to an intermediate temperature of about 48 F when the system is operating at full-load. It then goes to the centrifugal chillers, where it is lowered to 44 F.

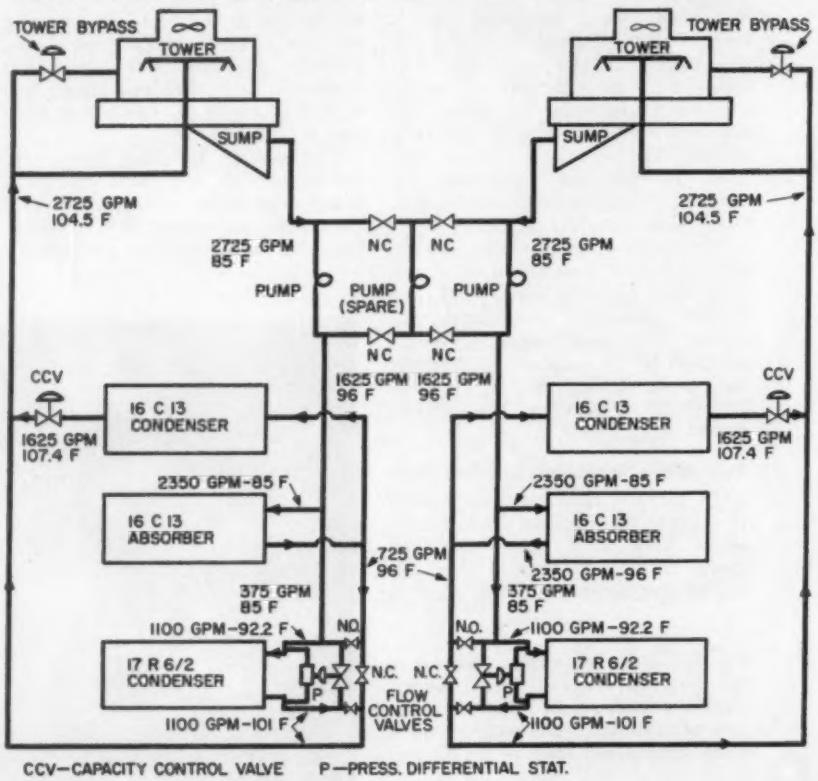
When operating under full capacity, the machines interact automatically to proportion the total load. As the load drops, the temperature of water leaving the absorption machine decreases several degrees. A sensing bulb in the line for chilled water leaving the centrifugal is connected to a recording temperature control which governs the speed of the turbine as the load fluctuates or as the amount of back-pressure steam goes above 13 psig. Should this pressure go above safe limits for the absorption unit, controls stop the turbine.

In the condenser-water circuit, Fig. 5, water from the cooling tower passes first through the lower or absorber shell of the absorption machine. The flow then splits, two-thirds going to the condenser of the absorption machine and one-third to the centrifugal's condenser. An additional 375 gpm is supplied to the centrifugal's condenser directly from the tower. A by-pass line keeps the temperature of water leaving the tower constant.

What about start-up? Normal procedure is to start with the absorption machine at light-load. The back-pressure regulator should be set for steam to enter the absorption unit at 2 psig. The steam valve to the turbine is closed. When between 50 per cent and 70 per cent of total load for the combination is being provided, the steam valve to the turbine is opened starting the centrifugal. When the back-pressure between the turbine and absorption chiller builds up to two pounds, the pressure-reducing valve closes and the absorption machine operates on steam exhausted by the turbine. Automatically proportioning the load between them, they operate continuously until shutdown, when the start-up procedure is reversed.

This system was placed in operation in the spring of 1959, when IH opened its new Research and Engineering Center. Its performance has lived up to expectations, resulting in attractively low steam rates, flexible operation, and economy of condensing water. THE END

Fig. 7. Schematic diagram of condenser water circuit. See text for explanation



WRAP IT LIKE THIS... TO BEAT THE SEA BORERS

90/10 COPPER-NICKEL SHEATHING MAY BE THE ANSWER TO DETERIORATION OF POLES SET IN SEA WATER

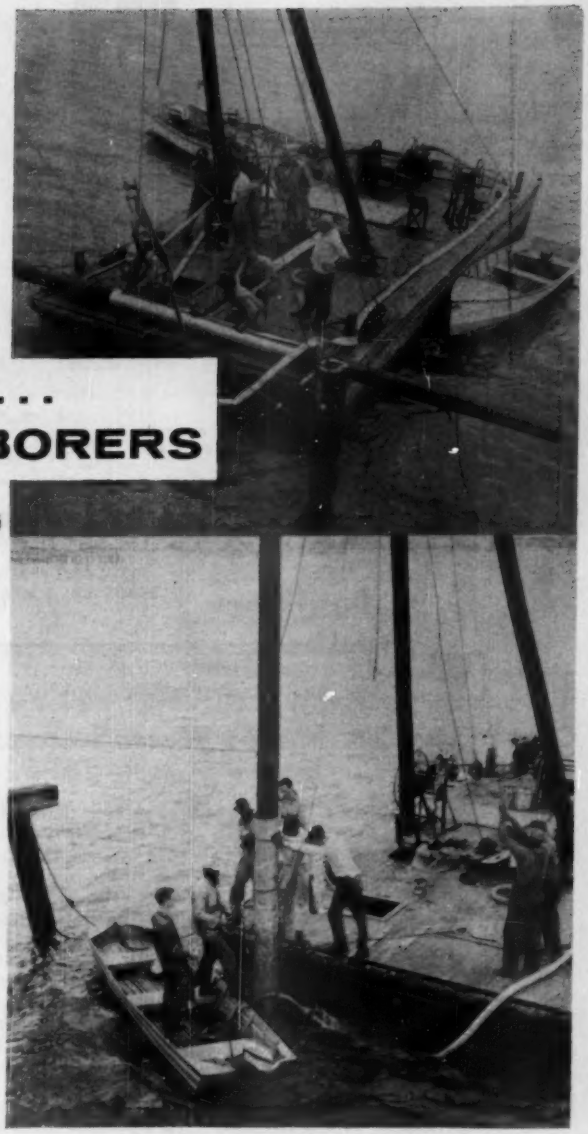
CAROLINA Power & Light Co reports a promising experiment in the prevention of damage to power line poles by the almost microscopic sea borers, Limnoria and Teredo.

It takes only a short while for salt water to leach the creosote from the outer surface of a pole, which reduces the toxicity to a level low enough so that the Limnoria can attack without being affected by the creosote. Hundreds of borers attack the pole at the same time, etching the surface and making the pole look like a sieve. As the Limnoria move toward the heart of the pole, they are usually joined by the somewhat larger Teredo borer. Severest damage to the pole is at the level of mean low tide and at the mud line.

Working jointly with International Nickel Co in a search for an answer to this problem, Carolina Power & Light has installed three test piles in Banks Channel, which divides Harbor Island from Wrightsville Beach. Each pole is protected by a strip of copper-nickel sheathing wrapped snugly so that it will extend from 1 ft below the permanent mud line to 2 ft above mean low tide. Rectangular in shape, the sheathing is 40 in. by 10 ft and 20 mils thick. The sheet weighs about 32 lb and costs $28.80, the company states.

The sheathing is overlapped around the pole and fastened in place by 2-in. Monel anchor fast slating nails spaced about every 2 in. down the seam and around top and bottom. If more than one 10-ft section is needed, the second piece is overlapped about 2 in. and nailed in place. Nails cost around $2.50 per lb. They are very durable in sea water and creosote, and prevent any galvanic action with the copper-nickel sheath.

P. B. Ross, Wilmington district engineer for the power company, explains that no attempt was made to waterproof the sheath. Theory is that any borers which may get between the sheath and pole will die either from lack of oxygen in the stagnant water, or from the high concentration of creosote in this small amount of water, or from the concentration of the copper elements in the water due to the presence of the sheath.



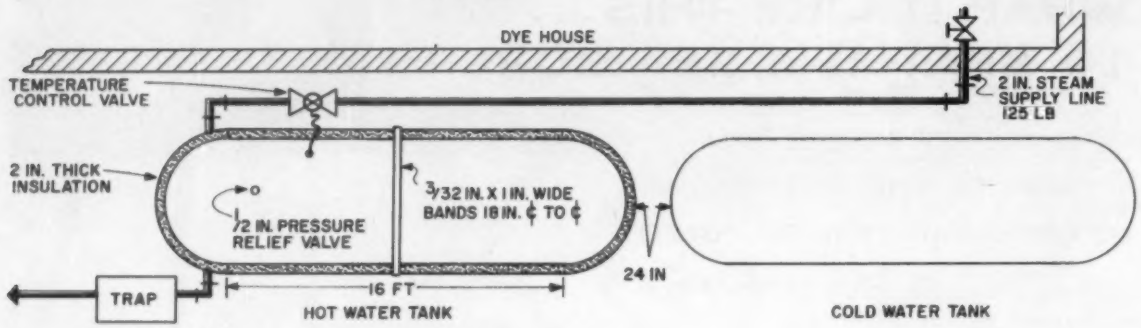
In upper view, pole is wrapped for protection at mud line and low tide mark. Then high-pressure stream of water digs hole at butt of the pole, for installation

Ross reports that length of sheathing required was predetermined by sounding the water depth at each location. From previous experience with piling at this location, a penetration of approximately 20 ft could be expected. All pilings were jetted down, butt first, to the required depth. A tide gage at the Harbor Island Test Station was used to determine when the proper penetration had been obtained. After obtaining the proper depth, the piles were than raked slightly away from the line, since they were to be used as guy stubs to support overhead circuits feeding Wrightsville Beach.

Present life expectancy of these piles is from eight to ten years. Life expectancy of the copper-nickel sheath is 40 years. Cost to protect the three piles with this sheath was $47 per pile, which is 85 per cent of the cost of the pile. A considerable saving can be realized if this experiment proves worth while, since the labor cost to install the three piles was $550. THE END

HANDBOOK

Power Engineering


DYE HOUSE
TEMPERATURE CONTROL VALVE
2 IN. STEAM SUPPLY LINE 125 LB
2 IN. THICK INSULATION
3/32 IN. X 1 IN. WIDE BANDS 18 IN. ¢ TO ¢
½ IN. PRESSURE RELIEF VALVE
24 IN
TRAP
16 FT
HOT WATER TANK
COLD WATER TANK

Case of the Overheated Water Storage

By C. T. BAKER

THE FIGURE shows how two water storage tanks were installed in an industrial plant that used large quantities of both cold and hot water as well as large quantities of steam in process work. Both tanks had been in service several years before the hot water storage tank was insulated to prevent the loss of heat, which was considerable during the cold months because of its outdoor location.

Steam to the heating coil was controlled by a double-seated thermostatic valve which was set for 180-deg water temperature. The 2-in.-thick insulation was mitered to fit the curvature of the shell and heads and was held in place by steel bands as shown.

A horizontal check-valve was located on the city make-up supply line to prevent back flow of water into the city mains if and when the pressure within the tank exceeded the city pressure of 45 to 50 lb, gage.

About a month after the tank had been insulated, several of the steel bands around the insulation were found broken and the insulation pushed back from the shell a considerable distance. An investigation looking for the cause of the disturbance disclosed the following:

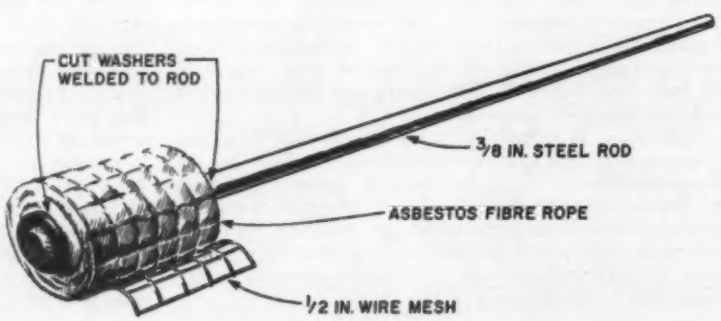
1. The half-inch relief valve was inoperative due to corrosion.
2. Steam modulating temperature control valve was leaking badly.
3. Valve seats were badly cut as a result of failure to protect the valve with a strainer.
4. Following the installation of the 2-in. steam supply line, which replaced an earlier 1½-in. line, no one thought to blow out the new line to remove pipe scale and sand; consequently, with no strainer in the line, the seat was badly damaged, which prevented the steam supply from being completely closed to the heating coil. At night no hot water was used; so dangerous pressures could easily build up within the tank.
5. The small relief valve was not adequate to the pressure-relieving requirements of the tank. The new valve was a combination pressure and temperature relief valve meeting the requirements of the ASME Code.

No one knows what pressures were reached within the tank at the moment of the breaking of the steel bands and the displacement of the insulation; however, there is no question but that a very dangerous condition was created.

Torch for Lighting Fan-Mix Burners

By JAMES B. RYDER, Louisiana Mill Power Plant, International Paper Co

THE SKETCH shows how we made up a torch for lighting gas or oil burners in our plant. It eliminates those frayed and loose ends of asbestos which come apart after a short time in use. In our torch, asbestos fibre rope is wrapped around the rod between the washers, and ½-in. wire mesh is wrapped with the asbestos rope and laced with steel wire. This makes a neat, longer-lasting torch. Cut the steel rod to desired length.



WHERE DO YOU STAND ON COMPUTER CONTROL— LEADING OR LAGGING?

Far-sighted leaders in industry are realizing the benefits made possible by applying computer control systems to their processes.

Working with these leaders, General Electric has already pioneered the application of twenty on-line GE-312 computer systems now being implemented in these basic areas —STEEL, ELECTRIC UTILITIES, CHEMICAL, CEMENT, and PRODUCTION CONTROL for various manufacturing applications.

The GE-312 Computer Control System embodies adaptability and flexibility to meet many types of applications in varying size plants. For example, compare its expansible memory—capacity up to 52,000 words. Compare its flexible input/output—capable of scanning up to 1500 instrument inputs. These are maximum capabilities, expansible from a minimum system. You buy a system tailored to your exact requirements.

Add to this versatile equipment the computer systems engineering ability demonstrated by General Electric in implementing these twenty GE-312 system applications.

Add also the long history of General Electric overall systems know-how—its broad background in the equipment, processes and materials to which you apply computer control.

Tomorrow's profits will come from today's combination of vision, equipment, and know-how. *Where do you stand?*

There are General Electric Sales and Application engineers in over one hundred offices throughout the nation to serve you. *Phone* the nearest General Electric Apparatus Sales Office, or *wire* General Electric Computer Department, 13445 North Black Canyon Highway, Phoenix, Arizona.

PROCESS CONTROL
AUTOMATED BY GENERAL ELECTRIC

Progress Is Our Most Important Product

GENERAL ELECTRIC

CPA-50 (9-60)

General Electric—a pioneer in computer systems for all phases of business, industrial, scientific, engineering, and financial endeavor.

For more data circle 531 on Post Card

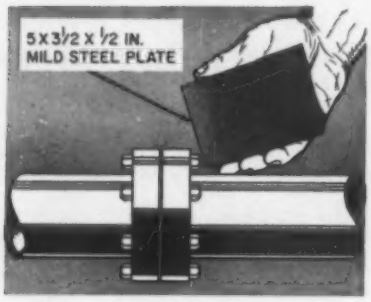
Useful Shop Ideas

By CHARLES H. WILLEY

TWO-IN-ONE screw driver can easily be made, as shown in Fig. 1, and comes in very handily for loosening stubborn screws. Smart blows with a hammer seat the tool in screw slot and jar the screw, making it then easy to remove with the driver end.

Need a quickly attached extra drill press platen extension shelf? Figure 2 shows how it can be done. Form the shelf out of ⅛-in. sheet iron, then use the 1-piece clamp riveted to edge.

Figure 3 shows a screw holder shopmade from tubing and spring wire. It's very effective for starting screws in hard-to-reach or dangerous places. The squeeze-handle closes loop around the screw. After starting the screw, handle is released to open the loop and let the head pass through.



How to Locate That Superheated Steam Leak

By A. BEN-AVRAHAM, Reactor School, O.R.N.L., Oak Ridge, Tenn.

WE OFTEN had cases where superheated steam was escaping from fittings flanges or packings in a location where many valves, traps, etc, were installed rather close together. It was difficult to locate the leaking joint because the superheated steam could not be seen. By moving a mild steel plate slowly around the suspected joint, the leak could immediately be located by the formation of water droplets on the plate, caused by the condensation of steam.

Best results are achieved with a rusty plate which has been only slightly brushed to remove the rust flakes, but not the brown rusty color. It is difficult to see the droplets on a shining plate.

Doubling the Wear of Conveyor Belts

By S. CLARK, Maintenance Supervisor, U. S. Phosphate Co, Tampa, Fla.

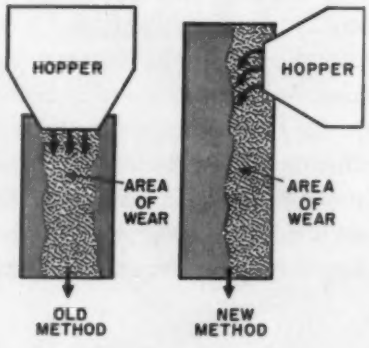
CONVEYOR BELTS loaded with rock, gravel and other abrasive materials are commonly turned end for end, or 180 degrees to lengthen the belt's useful life, since the wear is equalized in that fashion.

However, since it was painfully obvious that loading the belt in the middle made it wear out so that it was useless to turn it, we arranged a far more economical belt run.

The belt installation was made so that the load falls on the belt over one side — from the center to its edge. Thus the point of impingement of the load while falling on the belt and traveling on it, is distributed from center to edge.

As a result, the wear takes place on one side of the belt.

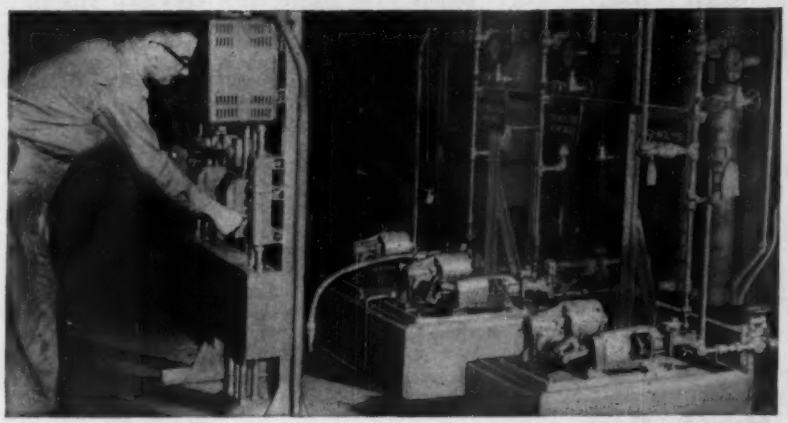
Now when the belt is reversed, end for end, we get more than double the wear, as compared with carrying the load in the middle of the belt and permitting impingement to occur directly in the center at all times.



Power Engineering HANDBOOK

how to select the right metering pump for water treatment

SOFTENING, demineralizing, pH control, oxygen scavenging . . . all of the treatments commonly applied to water place special demands on chemical feed systems. Chemicals must be metered to a high degree of accuracy, but many of them, particularly the strong acids and alkalies, are themselves highly corrosive. Through the years, controlled volume pumps have proved the ideal metering technique in this field, combining accuracy, controllability, and corrosion resistance. But the question often arises, "Which controlled volume pump design is best for my water treatment needs?" Here are a few practical suggestions based on actual experience.



Standard Milton Roy MD pumps meter ammonium hydroxide to maintain desired boiler feedwater pH at Ohio Power Company. Milton Roy miniPumps also feed minute amounts of hydrazine to remove residual oxygen from feedwater at this generating station.

PUMP SELECTION GUIDE

FOR	USE THIS PUMP TYPE
Coagulation	
alum	MD
silicate	MD
Demineralization	
acid regeneration	Diaphragm / Mersemetric
alkali regeneration	Diaphragm
Softening	
conc. phosphoric acid	Diaphragm
conc. sulfuric acid	Diaphragm / Mersemetric
lime slurries	MD
phosphates	MD / H20
soda ash solution	MD
Oxygen Scavenging (Boiler Water)	
sodium sulfite	MD / H20
hydrazine	MD / miniPump
Calcium Precipitation (Boiler Water)	
phosphates	MD / H20
Carbon Dioxide (Boiler Water)	
neutralizing amines	MD / H20
filming amines	MD / H20
pH Control (Boiler Water, Process Water, Cooling Towers)	
caustic soda	Diaphragm / Mersemetric
sulfuric acid	Diaphragm / Mersemetric

Packed plunger pumps . . . MD, H20®, miniPump®

The standard Milton Roy MD pump is usually the first choice for metering water treatment chemicals. Highly accurate, its capacity is readily varied manually or automatically in response to treatment demands. A wide variety of materials of construction from cast iron to stainless steel withstand all mildly corrosive treatment chemicals. Capacities to 2056 gph, pressures to 1000 psi. *Bulletin 553-1.*

Non-corrosive chemicals can be metered economically with the H20 pump if constant speed operation is satisfactory. Though it cannot be adjusted in operation, this low cost pump is ideal for feed to packaged boilers. Capacities to 28 gph, pressures to 600 psi. *Bulletin 558-3.*

When extremely small volumes of chemical, from 20 to 2940 milliliters per hour, must be metered to accuracies of 1%, the Milton Roy miniPump is the right answer. That's why this design is just about standard for metering hydrazine in oxygen scavenging. Pressures to 1000 psi. *Bulletin 1257-2.*

Diaphragm liquid ends

The best pump for highly corrosive or otherwise dangerous treatment chemicals is the diaphragm pump, with a stainless steel or plastic diaphragm isolating the plunger from the treatment chemical. Positive air purging at each stroke eliminates any chance of air binding. And the diaphragm liquid end is readily interchangeable with the packed plunger liquid end of the standard MD pump, permitting economical modernization in the event of a change in metering requirements. Capacities to 400 gph, pressures to 2700 psi. *Bulletin 1157-2.*

Totally immersed liquid ends . . . Mersemetric®

Many special metering problems are easily solved by Mersemetric controlled volume pumps with the liquid end submerged to a depth of up to fourteen feet. Chemicals can be metered directly from storage tanks without any need for tank connections below liquid level. Mersemetric pumps are widely used to feed sulfuric acid to cooling tower water and deaerator effluent, and sulfuric acid or caustic soda for demineralizer regeneration. Capacities to 218 gph, pressures to 1200 psi. *Bulletin 1153C.*

If precision pumping of boiler water treatment chemicals is one of your problems, look again to Milton Roy's 25 years of experience for your most economical solution. Milton Roy Company, 1300 East Mermaid Lane, Philadelphia 18, Pennsylvania.

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Using Black Light to Locate Leaking Condenser Tubes

By **EDWARD SWITOW,** Engineer, Louisville Gas & Electric Co

WITH PRESENT-DAY boilers and turbines operating at higher pressures and temperatures, it is of the utmost importance to prevent raw cooling water used for condensing steam in the main condenser from entering the condensate system through leaking tubes.

During a major unit overhaul it is important to check the main condenser for leaking and faulty rolled tubes and make the necessary repairs at this time. We have found the following method to be very successful.

After the intake and return water boxes of the main condenser have been opened and cleaned of debris, and the low pressure spindle removed, the maintenance crew can proceed to check for leaking tubes as follows:

Fill the steam side of the condenser with softened or treated water to a level above the top row of tubes. Inspect the tube sheet from the return and intake water boxes for any large or obvious leaks, and repair these with wood or brass plugs. After all large visible leaks have been repaired, the check for small tube leaks and faulty rolled tubes can be undertaken using the black light method.

Prepare a solution using one pound of water-soluble Fluorescein in two gallons of water. Admit this solution into the treated water already in the condenser. Use an air hose to agitate this mixture for several hours before starting to check for leaks.

Using a source of "black light," or ultra-violet light, examine the tube sheets on both the intake and return water boxes. Under the influence of black light, any Fluorescein-bearing water that has seeped through a pin hole in a tube or that has weeped through a faulty rolled tube will fluoresce very brightly. Tubes that are found to be leaking can be easily seen and readily repaired.

After a tube has been repaired, sponge off the dye with treated water and shine the black light on the repaired tube to verify the repair.

How to Cure Noisy Drive Assemblies

By **MICHAEL GIRONE,** Chief Engineer, Elizabeth General Hospital, Elizabeth, N. J.

VERY OFTEN engineers will encounter conditions causing excessive coupling insert wear or noisy drive assemblies. Generally these conditions are the result of misalignment either in the original assembly at the factory, or the removal or replacement of one section of the unit for repairs or other reasons.

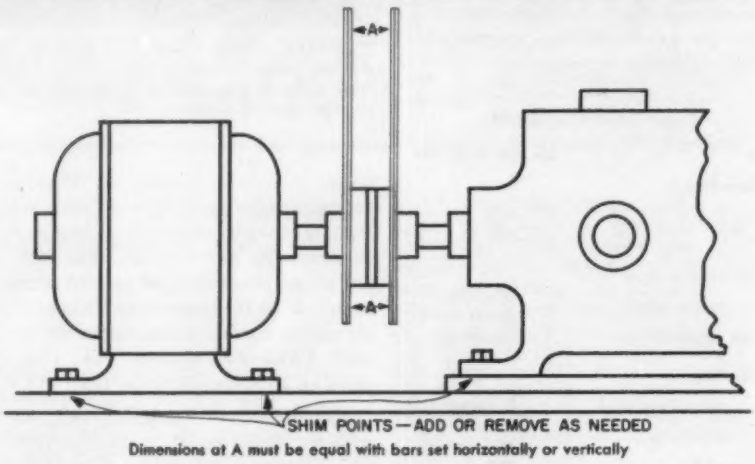
I have used the following trick many years with amazing results. All that is required is a pair of inside calipers and two pieces of square key stock 12 in. long by $\frac{3}{8}$ in. thick. Sizes are arbitrary and can be altered to suit the job. There are three basic steps to follow:

1. Set horizontal coupling clearance so that both halves are the same height. This is done with a small straight edge set on top of coupling parallel to shafts.

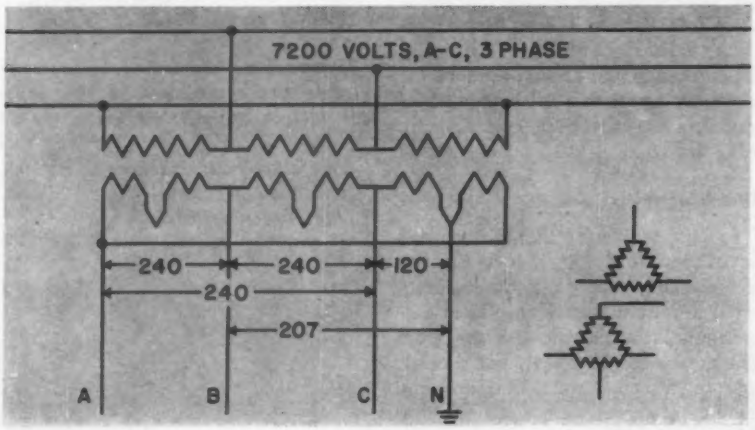
2. Hold parallel bars in a horizontal position with one hand against outside flanges of coupling, and with calipers measure distance between bars at each end. If measurements differ, loosen holding bolts and shift unit laterally until the dimensions are equal.

3. In the same manner set the bars in a vertical position and repeat the procedure. During alignment, coupling halves may be different heights, so that shims may have to be removed or added at hold-down points to compensate for the difference. Once the units are parallel, steady pins will keep them that way.

Conditions may compel you to alter the procedure, but the end results will be the same.



Dimensions at A must be equal with bars set horizontally or vertically



Correction . . .

In this department in July, Paul Ziemke's article, Performing Polarity Test on Transformers, page 75, contained an error in Fig. 2. Primary and secondary leads were represented in that figure as running into each other. This was an error in drafting, and certainly not intended by the author. Our apologies to all. In the corrected drawing, left, mid-tap rather than corner-of-the-delta grounding is shown. This conforms to better practice.

Power Engineering HANDBOOK

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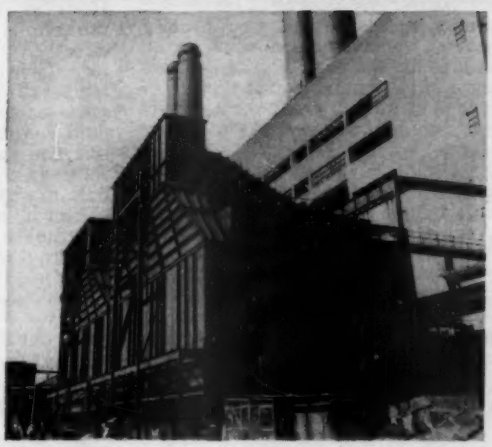

** In addition to the Cottrell installations shown, Research-Cottrell has also completed or begun three more large 99% fly ash installations rated at 3,360,000 total cubic feet per minute. Two of these are repeat orders based on the excellent performance of those in service.*

Yes—99% is a rigid requirement. And it obviously requires the *best* in Cottrell precipitation equipment.

So—is there any wonder that Research-Cottrell is proud of the fact that they have fly ash precipitators in and operating in full compliance with this specification—also, that Research precipitators are *consistently* chosen for problems of this magnitude.

Research is the *only* company that can point to several large 99% fly ash installations. What's more—*repeat orders* give further proof of the high quality of the equipment and the high degree of performance of the Research precipitators.

So, for your own fly ash collection problem, doesn't it make good sense to place your confidence in the company and equipment with this proven performance?

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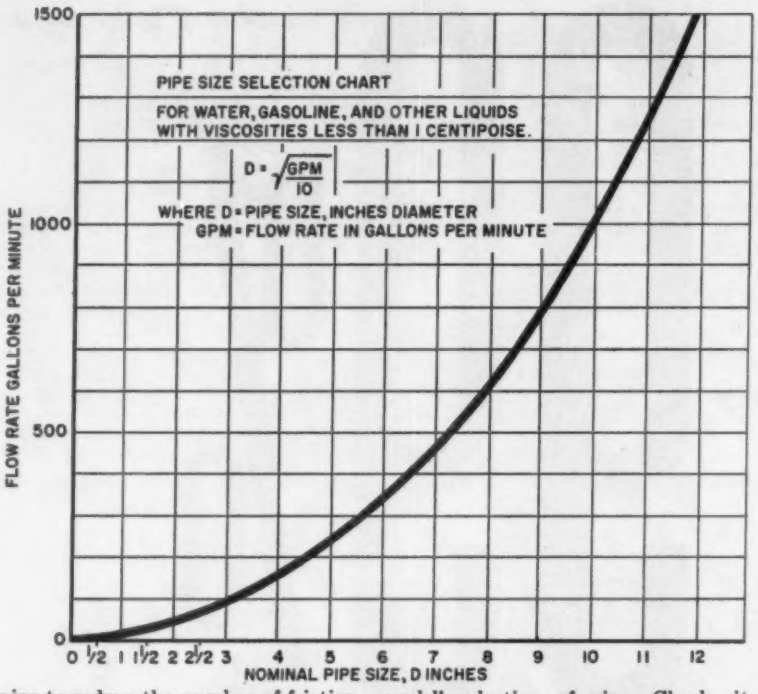
Quick Method for Sizing Pump Lines

By JOHN D. CONSTANCE, P.E.

HOW MANY TIMES have you been in the field or plant and had to size a pipeline flowing water or any other liquid having the viscosity characteristics of water, i.e., less than one centipoise? (This discussion is to be confined to cold water and doesn't cover hot or flashing water flow, as in condenser drain lines to feedwater pumps). You don't have pressure drop tables or hydraulic slide rule, but you must size the pipe to keep the job moving.

For a given length of pipe the pressure needed to fight pipe friction is almost inversely as the diameter and directly as the square of the flow or velocity. Under normal conditions suction head is constant and suction velocity to a pump is in the neighborhood of 4 fps. The graph shown plots gpm vs pipe size for the above condition. Thus, a line flowing 100 gpm of water may be sized as 3 in. The discharge line leaving the pump may be sized one size smaller, i.e., 2½ in.

This graph may also be used in determining the general size for a pipe to reduce the number of friction loss calculations. However, it has proved quite useful in general "ball park" selection of pipe. Check it against standard calculations and see for yourself.


PIPE SIZE SELECTION CHART
FOR WATER, GASOLINE, AND OTHER LIQUIDS WITH VISCOSITIES LESS THAN 1 CENTIPOISE.
$D = \sqrt{\frac{GPM}{10}}$
WHERE D = PIPE SIZE, INCHES DIAMETER
GPM = FLOW RATE IN GALLONS PER MINUTE
FLOW RATE GALLONS PER MINUTE
1500
1000
500
0
0 ½ 1 1½ 2 2½ 3 4 5 6 7 8 9 10 11 12
NOMINAL PIPE SIZE, D INCHES

Fuel Oil — Weigh It or Measure It?

By C. T. Minnich, Sup't, Production, Plant Dept, City of Grand Island, Nebraska

THIS DEPARTMENT has always had trouble striking a balance between oil received, fired and on hand at the end of each fiscal year. The management has been liberal in the past in accepting an overage or shortage of 2000 or 3000 gallons as a reasonable accounting spread. We fire natural gas most of the time, but lately, especially last two heating seasons, we have fired as much oil, all told, as for the past 17 years. On account of the hundreds of thousands of gallons of fuel oil fired, our accounting system must be held to closer figures.

Our difficulty in the past has been trying to measure gallons, which vary with temperature delivered, specific gravity and temperature metered. With so many variables, the accounting results in some wild stabs. This difficulty, we believe, can be largely overcome by weighing the fuel in definite pounds, rather than measuring in variable gallons. The fuel is delivered by weight as well as gallons at 60 degrees. Total storage can also be continually weighed, regardless of specific gravity or temperature by means of the simple mercury column. We prefer the mercury column to the gage, since the former does not require calibration.

This method of weighing a tank of fuel oil is well known but not very well recognized, and often disputed. However, it is a fact that the scale of the column can be calibrated to read directly in total pounds' storage, regardless of the specific gravity or temperature of the contents. The same scale will read the weight of any fluid contents. Once we understand this, the construction of the mercury column, and installing same below bottom of the storage tank, becomes a simple matter. The mercury well may be connected to the oil suction line from tank to pump, the reading being made with the pump off for a few seconds. This is not as good as a separate connection from tank to gage, but it is the way we do it.

The accounting of the fuel is then based on a definite figure in pounds. The fuel fired during the month is easily read and determined by the readings of the column so that the fuel fired and fuel in storage always balance in pounds. The combustion and efficiency figures are also directly calculated from pounds of fuel. Should the fuel oil meter be calibrated in gallons, it can be reduced to pounds by having an API hydrometer on hand and knowing the temperature at which the fuel is metered. Any discrepancy at the end of the month between oil in storage and fired can be laid to the fuel-oil firing meter, and adjustment made.

By following this method of accounting of fuel each month, the balance between fuel oil received, fired and in storage at year's end will come out even.

In case readers wish to experiment with this method of fuel oil measurement, a few words about the laying out of the scale for the column to fit the storage tank will be in order. The mathematics are not highly involved:

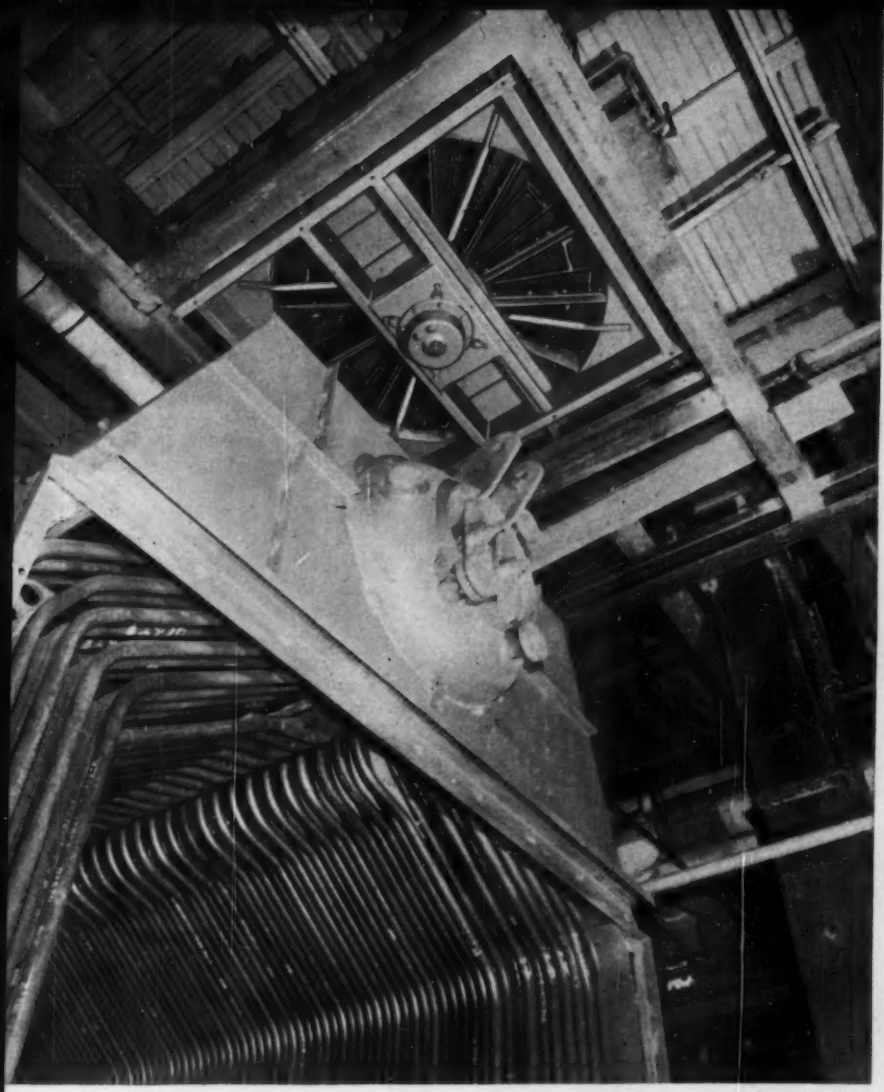
$$\frac{10620}{\text{Gal capacity/ft tank depth}} = \text{inches of scale per } \frac{100{,}000 \text{ lb storage}}{}$$

Example: Tank diameter 45 ft has capacity of 11,922 gal per ft storage.

$$\frac{10620}{11{,}922} = 0.891 \text{ in. on scale of mercury column per } 100{,}000 \text{ lb storage of any liquid.}$$

This formula applies only to flat bottom, vertical-sided tanks.

Power Engineering HANDBOOK



The Ljungstrom Air Preheater at the B. F. Goodrich Company Shelton Plant is installed directly over the 65,000 lb/hr Wickes boiler. Flue gas leaving the boiler at 615°F passes through the circular rotor, which absorbs the heat and releases it into the incoming air. Preheated combustion air improves combustion, makes fuel burn cleanly. This Package Air Preheater was factory-assembled, and requird only 100 manhours to install.

At B. F. Goodrich Co.'s Shelton Plant

Air Preheater boosts combustion air temperature 345°F... gives 6% more thermal efficiency

"Only a Ljungstrom® Air Preheater, with its continuous regenerative principle, could meet our requirements", says A. G. Sandomirsky, Manager of Engineering at the B. F. Goodrich Company, Shelton, Conn., plant. "We produce foam rubber 24 hours a day, five and six days a week. With an Air Preheater we can meet process steam requirements more economically, and an Air Preheater helped us to justify the installation of high efficiency, high pressure equipment for by-product power generation."

Here's why the Shelton plant meets its requirements best with a Ljungstrom Air Preheater:

1. Ljungstrom is the most efficient heat exchanger you can buy. The Ljungstrom rotor revolves continuously through the flue gas and incoming air, thus absorbing heat and releasing it *from the same surface.* Since the heat doesn't have to pass through anything, each inch of rotor surface is as efficient as one foot of a tubular recuperator.

2. Ljungstrom is the most reliable heat exchanger you can buy. All heat exchange elements pass through the entire air and gas streams. The temperature of the elements in the coolest region — where fresh air enters — is actually an average of the gas and air temperatures, so it's consistently higher than the coolest point in a recuperative heat exchanger. Result: no cold spots, less chance of moisture formation.

3. Ljungstrom is easiest to maintain. You can inspect it — and clean it—while it's running. Heat exchange elements are divided into modular baskets that can be replaced individually without disturbing the other elements. You can even reverse the elements if the surface has thinned on one edge, effectively doubling the life of the heat exchange surface.

For more information on the Ljungstrom continuous regenerative principle, or on the Air Preheater that meets your requirements, phone MUrray Hill 2-8250 or write to The Air Preheater Corporation.

THE AIR PREHEATER CORPORATION

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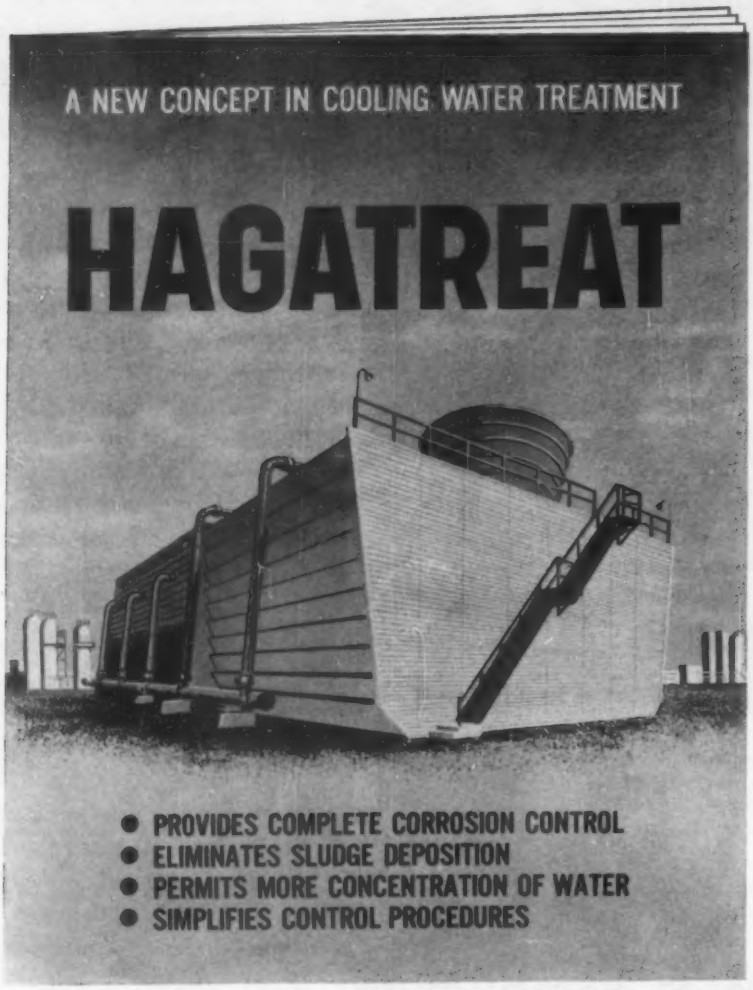
a new bulletin on a new product by Hagan


A NEW CONCEPT IN COOLING WATER TREATMENT
HAGATREAT
● PROVIDES COMPLETE CORROSION CONTROL
● ELIMINATES SLUDGE DEPOSITION
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Hagatreat, an entirely new concept in the treatment of cooling water, prevents scale and sludge formation in the system and permits higher concentration of make-up water. Results, savings in both chemicals and water costs. In tests covering several years, corrosion of both steel and copper was held to a minimum unmatched by any previous inhibitor.

Get the complete story. Bulletin CSP-935 contains all the information on applications, plant handling, and test results. See how your cooling water system can operate more efficiently . . . more profitably. Write:

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MORE ABOUT—
Condenser Performance

Continued from page 62

in measurement of the circulating water temperature is an error of 10 per cent in flow. Naturally, the more temperature readings taken, the more accurate the determination of the true circulating water temperature.

Although, from a turbine standpoint, condenser vacuum is very important, it is not an indication of condenser performance. Very simply stated, condenser performance is the comparison of actual heat transfer rate to an expected heat transfer rate. Actual heat transfer rate is found from the following equation:

$$U_{test} = \frac{Q}{A \triangle T}$$

U_{test} = actual heat transfer rate, Btu/hr/sq ft/deg F Lmtd
Q = Duty, Btu/hr
Q may be also found by lb/hr steam condensed x enthalpy drop per lb of steam
A = Sq ft condenser
$\triangle T$ = Log mean temperature difference, deg F

$$\triangle T = \frac{T_2 - T_1}{\log_e 1 + \frac{T_2 - T_1}{T_s - T_2}}$$

T_2 = Circulating water temperature out deg F
T_1 = Circulating water temperature in deg F
T_s = Temperature incoming steam deg F (Corresponds to saturated temperature of exhaust pressure)

The expected heat transfer is found from the following equation from the Heat Exchange Institute (HEI):

$$U = C\sqrt{V} \times F_1 \times F_2 \times F_3$$

Where U = expected heat transfer rate Btu/hr/sq ft/deg F Lmtd
C = Tube diameter coefficient (Standard HEI)
V = Velocity of circulating water through tubes ft/sec
F_1 = Circulating inlet water temperature correction (Standards HEI)
F_2 = Tube material and gage correction (Standards HEI)
F_3 = Cleanliness factor, from design value

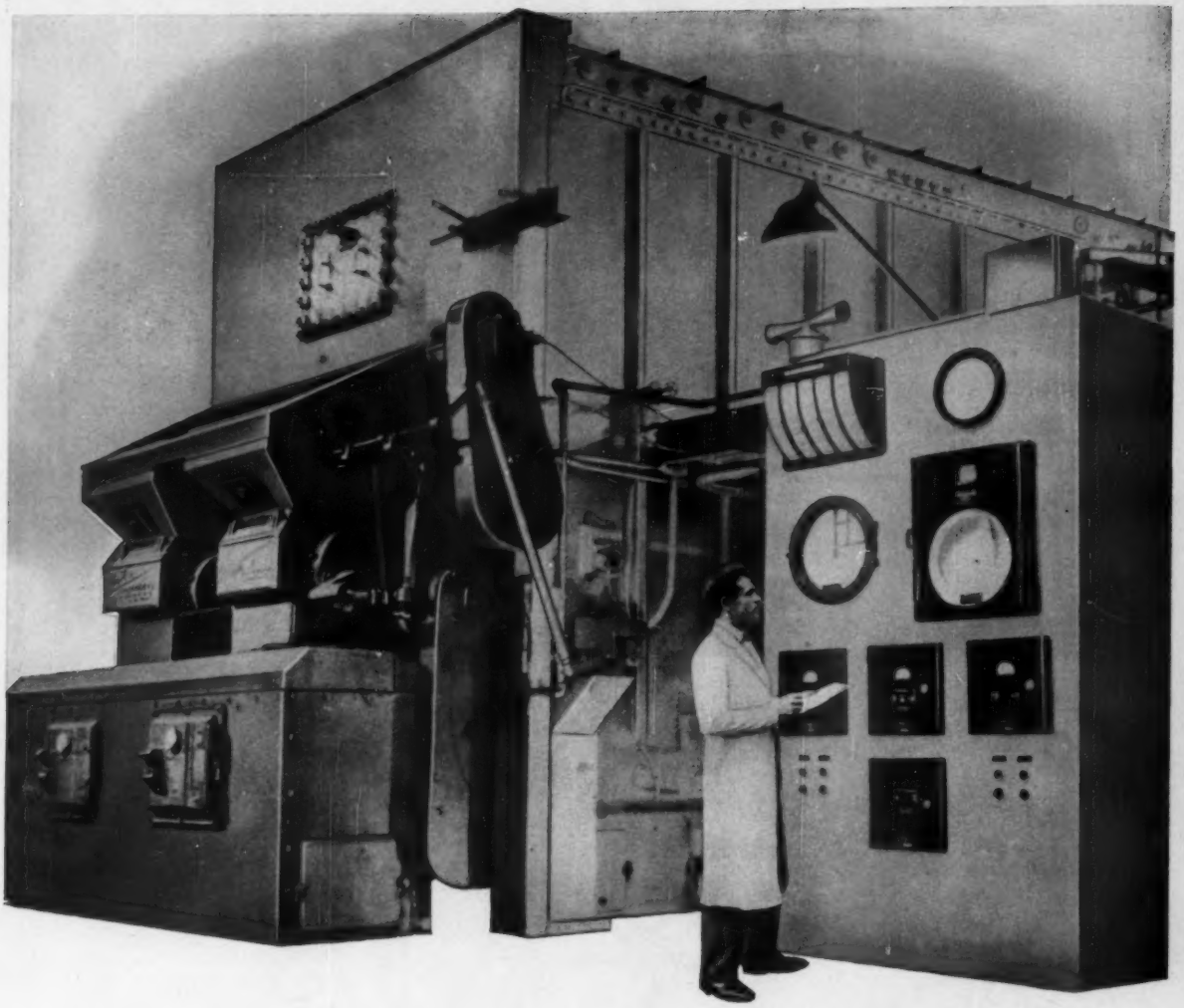
Heat Exchange Institute "Standards for Steam Surface Condensers" is very helpful in evaluating the above equation. $C\sqrt{V}$ and F_1 are found from Fig. SF-2; F_2, from Table ST-1 of that publication.

Then the condenser performance is evaluated, expressed as a percentage:

$$\text{Per cent} = \frac{U_{test}}{U} \times 100.$$

Operators and chemists should be interested in the deaeration performance of a condenser. There is a spot check method for determination of dissolved oxygen, using an indigo carmine and potassium hydroxide mixture. This method is being used by many utilities, and is fast, con-

Concluded on page 94



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You can bring this unit on or off a banked fire at the touch of a button. You can convert it to oil firing over a week-end. In actual operation and in exhaustive field tests this stoker-fired packaged unit has exceeded all expectations for capacity and efficiency.

Three standard sizes are available: 43,000 lb, 50,000 lb and 63,000 lb of steam per hour at 250 psi. All are shipped in three major sub-assemblies.

A complete line of standard oil and gas fired packaged steam generators is also offered in capacities from 13,000 lb/hr to 100,000 lb/hr. For complete information write to Foster Wheeler Corporation, 666 Fifth Ave., New York 19, N. Y.

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venient and fairly reliable, but should be considered only an operational check method unless compared in the plant to a referee method.

The referee or standard method should be the Heat Exchange Institute standard for "Method and Procedure for the Determination of Dissolved Oxygen." This is the method of ASTM D-888 with somewhat more detailed instructions and precautions.

Condensers are usually guaranteed to 0.03 cc per liter of oxygen or less, but under restricted conditions, 0.01 cc per liter is guaranteed. Under favorable conditions, lower values than the guarantee should be found.

Many plants now have oxygen recorders to give a continuous record of deaeration. These have been very beneficial in locating the cause of any periodic increases in oxygen due to load changes, faulty procedures in admitting drains, make-up. THE END

MORE ABOUT—
Air Force

Continued from page 71

quarters ADC, gave an excellent paper on the Operation and Maintenance of heating plants. This dealt primarily with the problems which have been encountered in heating plants in the Air Force. This talk gave many reasons why the installing contractor should take adequate precautions to instruct the plant operators, before leaving the job.

Final session on the agenda was a talk on Fuel Selection, given by Mr. Harry Ivins, of Headquarters USAF, followed by a panel on Fuels.

Mr. Ivins stated the policy of the Department of Defense, and the Air Force, for the selection of fuels to be used. This policy, basically, is to use the fuel which is most economical in operation, consistent with available supply. Therefore, a complete economic study must be made to determine the best fuel for all new plants, and also when converting from one fuel to another.

Consideration is given to oil, gas and coal as basic heating fuels. Mr. Ivins gave a complete discussion on the selection of fuels at individual bases. He pointed out that every factor must be carefully weighed, in addition to just the cost of fuel alone.

Editor's note: This Heat-Power Conference was one of the best we have had the pleasure of attending. Taxpayers, generally, would be delighted to know the sincerity with which the Air Force power engineers strive to conserve heat and power, and make the most out of the funds allotted for their operations. THE END

Compare

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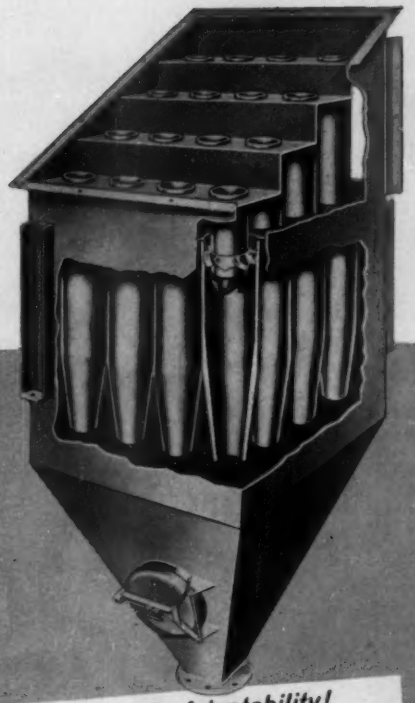
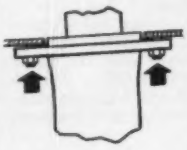


For cyclonic collection of dust or fly ash from all types of gases—hot or cold—no other equipment matches the *multiple* advantages you get in MULTICLONE Collectors. No wonder this small-tube equipment is so widely imitated—but only the genuine Multiclone combines so many important savings as these...

Compare Efficiencies!

Multiclone Collectors pioneered the modern small-tube concept of cyclonic collection. The Multiclone small-diameter tubes combine highest collection efficiency with minimum risk of plugging—and separate not only large, medium and small particles, but also an unusually high percentage of the extremely small particles (10 microns and less)!



Compare Maintenance!

Multiclone cast iron tubes and vanes seldom require servicing or replacement. But when unusually abrasive service makes occasional servicing necessary, the tubes (one or more, as desired) can be quickly replaced by simply unbolting the old tube and installing a new one. The cast iron vanes are supported in a tapered seat—are equally easy to service!

Compare Adaptability!

Multiclone Collectors can frequently be placed in otherwise waste-space locations too small—or not properly shaped—for other types of collectors. The shape of the Multiclone can be varied—short and wide, long and narrow, or square—to fit varying space restrictions. Moreover, the unit can be installed with side-inlet, side-outlet—or side-inlet, top-outlet—to fit plant layouts...and only a single inlet and outlet duct is required to service an entire bank of tubes. These multiple advantages add up to important savings in installation, in insulating costs, in space conservation!

Compare Compactness!

In addition to greater space adaptability, Multiclone Collectors also are unusually compact in themselves. For comparable capacity and performance, they require less floor space and less cubic space than do any other cyclonic units. Translate these space savings—plus Multiclone's adaptability to odd-shaped areas—into today's high costs for plant construction and you readily see how important Multiclone compactness really is!

Only Western Precipitation supplies ALL *7 major types of gas cleaning equipment—Precipitators, Cyclones, Hi-Temp Filters, Jet-Cleaned Filters, two types of Scrubbers, and Combination units ...your assurance of a completely unbiased recommendation on the equipment best suited to your particular requirements!*

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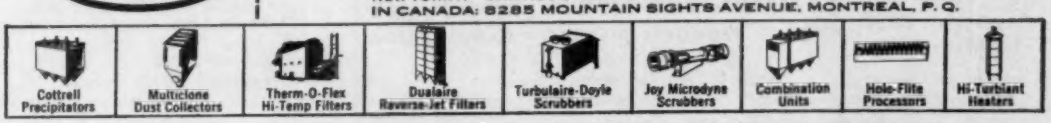

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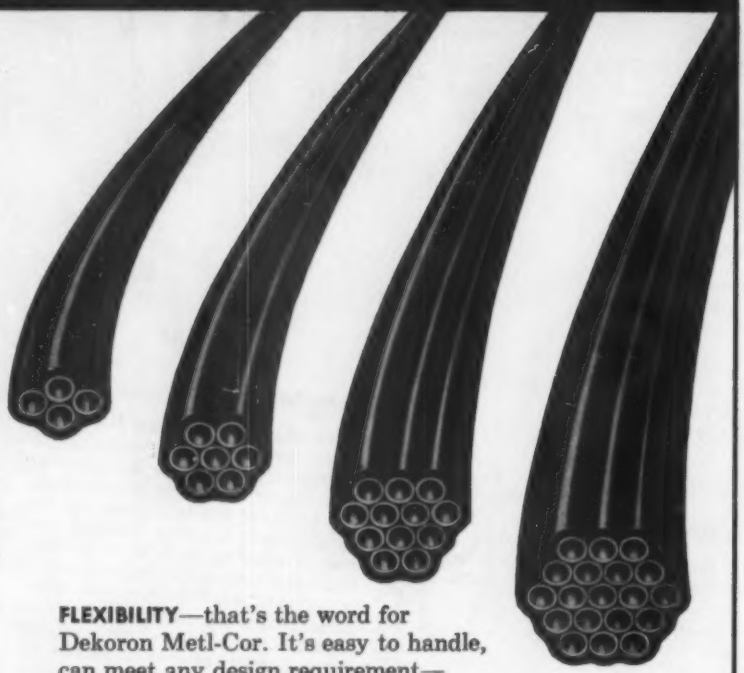
MULTIPLE TUBE HARNESS

cuts installation costs
bends without distortion
solves instrument line corrosion problems



FLEXIBILITY—that's the word for Dekoron Metl-Cor. It's easy to handle, can meet any design requirement—and it's highly corrosion resistant, too.

FIRST, Metl-Cor's exclusive Extru-Loc construction makes it easy to bend with no tube distortion.

SECOND, the Metl-Cor design is flexible. You can specify Metl-Cor with core tubes in either copper or aluminum . . . in any standard or special OD or wall thickness . . . with almost any number of tubes in each bundle.

MOST IMPORTANT, no matter which type or size you specify—you get all the inherent cost-cutting savings and longer life that you pay for. AA-7811

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CONSTRUCTION NEWS

Phoenix, Ariz. — Arizona Public Service Co, 501 South Third St, has announced plans for the construction of a new steam-electric generating plant between Holbrook and Joseph City, in the northern part of the state. New plant will have an initial capacity of 110,000 kw, and work will begin at once. Plant will use coal as fuel under a 35-year agreement with the Pittsburgh & Midway Coal Mining Co, of Pittsburg, Kans. Work on the new facility is scheduled for completion by the early summer of 1962, at a reported cost of approximately $19,000,000. New plant, the state's first large-scale coal-burning power plant, will bring the utility's total electric resources to 935,000 kw.

Little Rock, Ark. — Arkansas Power & Light Co, Simmons National Building, Pine Bluff, Ark, has authorized plans for extensions and improvements in its high-power electrical transmission system. Plans call for installation of a 90-mile high-power electrical transmission line from Helena to Pine Bluff, Ark, including the installation of 425 steel towers along the right-of-way. Work on the installation is already under way and is scheduled to be completed by the summer of 1961. Cost is reported to be approximately $5,000,000.

Los Angeles, Calif. — Board of Supervisors, Los Angeles County, 501 Hall of Records, Los Angeles, Calif, has authorized plans to construct a central boiler and refrigeration plant at Mira Loma Segregation Hospital, located here. Construction budget of $1,250,000 has been set aside for the work to be done by the Manco Construction Co, Inc, Long Beach, Calif. Work will begin at once for completion scheduled for the fall of 1961.

Norwich, Conn. — The State Department of Public Works, 165 Capitol Ave, Hartford, Conn, has authorized expansion and improvement of electrical distribution facilities at Norwich State Hospital, located here. Work will begin at once on the project which is scheduled for completion by early 1961.

Washington, D. C. — The Atomic Energy Commission, 1901 Constitution Ave, N.W., this city, has authorized plans for a joint proposal submitted by the cities of Los Angeles and Pasadena, Calif, to construct a 50,000-kw prototype nuclear power plant. Under the agreement, the municipally owned utilities will provide a plant site at San Francisquito Canyon, Los Angeles County. They will also build and operate conventional generating facilities for a five-year period and will purchase the steam produced by the reactor, which will be built and owned by the AEC. New plant is slated for completion by the summer of 1963. The above proposal was accepted over a similar proposal made by Western Farmers Electric Coöperative of Anadarko, Okla.

Tampa, Fla. — Tampa Electric Co, Cass & Tampa sts, this city, has announced that work on the installation of Unit No. 3 at its Gannon Power Station is well under way. The new unit, rated at 175,000 kw when completed late this year, will boost Tampa Electric's generating capacity to 735,000 kw. Cost is expected to be a multi-million dollars.

Continued on page 98

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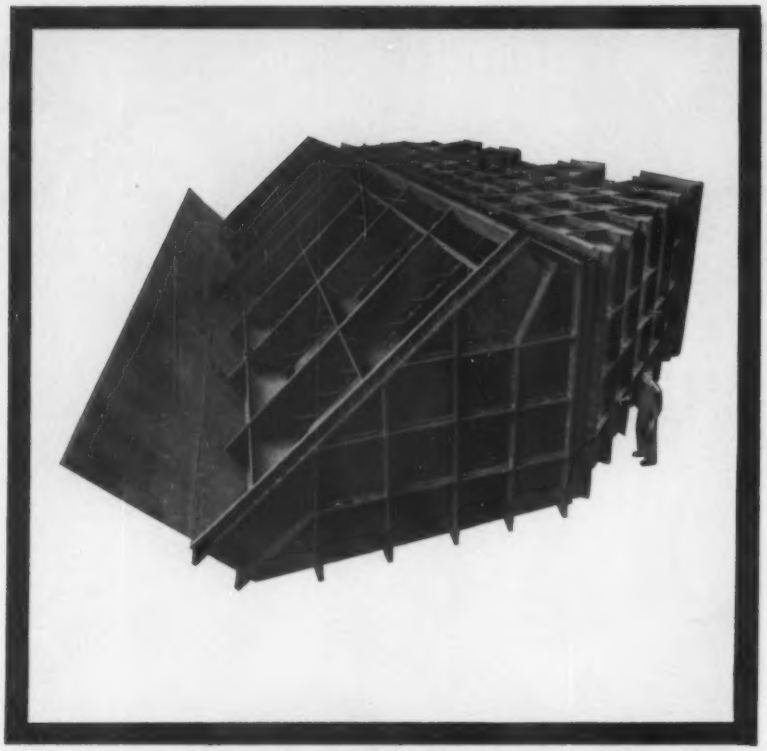

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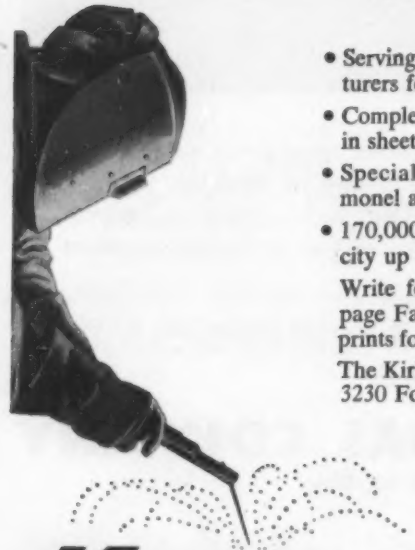

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Frankfort, Ind. — Municipal Electric Department of Frankfort, Ind, City Hall, has approved plans for new addition to municipal power plant to cost about $642,989, exclusive of equipment, and work will begin at once. Work will include installation of a new steam-electric generating unit under the direction of the Wicks Boiler Co, Saginaw, Mich, the successful bidders for the work. Plant will be completed early in 1962.

Garden City, Kans. —Municipal Electric Department, City Hall, this city, has plans in progress for expansion and improvements in municipal power plant, with installation of equipment for increased capacity. Appropriation has been authorized through a bond issue of $2,750,000 for the work, which will begin at once. Black & Veatch, West Kansas City, Mo, is project engineer. Project will be completed by the spring of 1962.

Dickerson, Md. — Potomac Electric Power Company, 929 E. Street, N.W., Washington, D. C., has plans under way on installation of a third generating unit at its Dickerson Power Plant, located here. Work will begin at once, under contract to the Bechtel Corp, 220 Bush St, San Francisco, Calif, who will design and construct the unit. New installation will be completed by the spring of 1962 and will represent an investment of between $25,000,000 and $30,000,000.

Mankato, Minn. — State Department of Administration, 19 State Capitol, St. Paul, Minn, has authorized plans for installation of two steam generator units at State College, located here. Work will get under way at once on the installation and improvement of the power plant at a reported cost of approximately $100,000. R. W. Evans & Associates, Minneapolis, Minn, are engineers of the project. Completion of the installation is slated for the spring of next year.

Minneapolis, Minn.—Northern States Power Co, 15 S. Fifth St, this city, under its own forces, has plans under way to install a large new transformer at its West Faribault substation for completion in 1961 at a cost of about $283,000. Plans also include the rebuilding of an 18.5-mile, 69,000-v transmission line between Waterville and owner's generating station at Mankato, Minn, to be completed late in 1961 at a cost of $320,000, doubling the capacity of Champlin Substation and increasing transformer and feeder capacity at a cost of $403,000 — for a total expenditure of $1,006,000.

New York, N. Y. — Consolidated Edison Company of New York, 4 Irving Place, has authorized a construction budget in excess of $1,000,000 for plant improvement and substation construction in Corona and White Plains, N. Y. Extensions will be made at the existing station at Corona, N. Y., involving about $500,000, and a substation addition will be made at company's White Plains station to cost a like amount. Work on the two projects has already begun under the supervision of Gibbs & Hill, Inc, New York, N. Y. consulting engineers, and will be completed by the fall of 1961.

Charlotte, N. C. — Duke Power Co, 422 S. Church St, has announced contract award to the Westinghouse Electric Corp, Pittsburgh, Penna, for three 700-ton waterwheel generators for company's Cowans-Ford hydroelectric plant on the Ca-

Continued on page 100

USED TO THINK EVERY STEAM TRAP LEAKED STEAM.

THEN I FOUND ONE THAT DIDN'T, BUT IT WOULDN'T VENT AIR.

FOUND ONE THAT VENTED AIR, BUT IT NEEDED A COOLING LEG.

DISCOVERED A TRAP THAT REMOVED CONDENSATE AT STEAM TEMP, -MAINTENANCE WAS TOO HIGH.

THEN I FOUND A ~~LOW~~ MAINTENANCE TRAP. IT DIDN'T WORK AGAINST BACK PRESSURE.

AT LAST I FOUND ONE THAT WORKED AGAINST BACK PRESSURE, BUT ITS CAPACITY RATING WASN'T DEPENDABLE.

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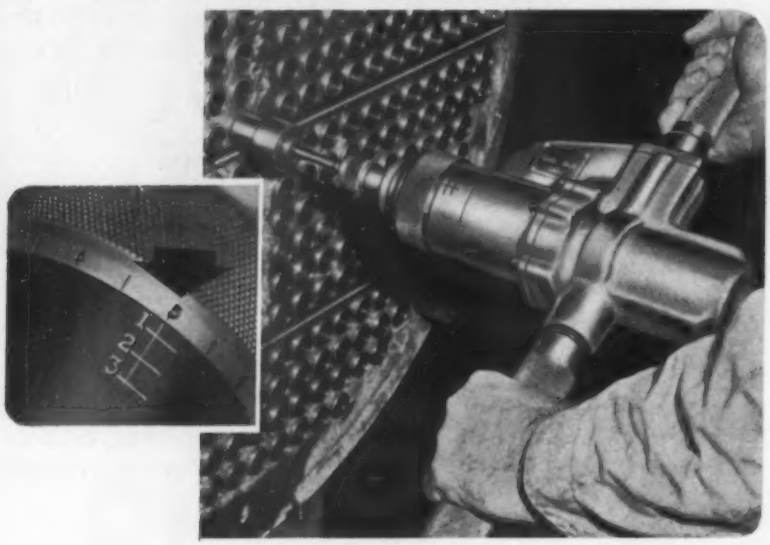

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tawba River in North Carolina. The three generators will be rated at 87,500 kw each and will provide an initial capacity of 262,500 kw at the plant. The generators are scheduled for delivery in May and September of 1962 and January of 1963. Plant, reported to cost over $60,000,000, will be completed late in 1963. A fourth generator with a capacity of 87,500 kw is scheduled to be added in the future when power demand in the area increases.

New Richmond, O. — Cincinnati Gas & Electric Co, Fourth & Main sts, Cincinnati, O., has authorized plans for construction of unit number five at company's Beckford Power Station, located near this city. Contract award in the amount of $800,000 has been made to the Penker Construction Co, Cincinnati. Work will start on the new addition at once. Plant is scheduled for completion by the end of 1961.

Oklahoma City, Okla. — Oklahoma Gas & Electric Co, 321 N. Harvey St, this city, has announced plans for a multi-million dollar addition and plant improvement program at its Horseshoe Lake Power Station, near here. Expansion program will make the station one of the nation's largest combined-cycle steam-gas turbine electric power generating stations. Plans call for the installation of a new steam-electric generating unit with an initial capacity of 200,000 kw, boosting the station's capacity to 468,000 kw. Plant will be completed late in 1963.

Eugene, Ore. — Eugene Water & Electric Board has announced approval by the Federal Power Commission of increases in cost and capacity of its Oregon Hydro-electric project. Board recently granted permission to the utility to make two of its dams earth-fill instead of rock-fill and to install larger generators. The changes will expand the project's capacity to 90,000 kw from the 53,000 kw originally proposed. Cost of construction will of course be boosted proportionately from the original $19,318,000 to approximately $25,000,000. Work on the project is proceeding according to plan and will be completed on schedule sometime in 1962.

Denton, Texas — Municipal Electric Department, City Hall, Denton, Texas, has begun work on the expansion and improvement of a municipal steam-electric power plant with installation of generating and auxiliary equipment for increased capacity. Plant is scheduled for completion in the fourth quarter of 1961 and will cost approximately $5,000,000 when completed. Black & Veatch, Kansas City, Mo, is the consulting engineer of the project.

Dayton, Va. — Shenandoah Valley Electric Coöperative has authorized plans for extensions and improvements in its distribution system serving Rockingham, Augusta, Shenandoah and Page counties. Plans include the construction of a 26-mile transmission line and 3 substations serving this area at a cost of about $1,270,000. Work will begin at once and is scheduled for completion by the first quarter of 1961.

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New Engineering Books

Manual on Industrial Water and Industrial Waste Water, second edition — 1959. ASTM Special Technical Publication No. 148-D, prepared by ASTM Committee D-19 on Industrial Water; 658 pages, 5¾ by 9 in. Published by the American Society for Testing Materials, 1916 Race St, Philadelphia 3, Penna. Price, to non-members, $11; to members, $8.

First edition of this comprehensive manual, published in 1953, was reprinted three times. Its editor — Committee D-19 — has noted that interest in industrial water now takes in not only the process-use aspects but the waste discharge problem as well. Therefore this new edition contains information on waste water as well as process water. The manual is intended as a brief reference source for three types of users: executives and plant designers; individuals working with industrial water at the operating level; and analysts, operators of special instruments, engineers and consultants. Part II presents the ASTM standards on industrial water and industrial waste water.

★ ★ ★

Power Generation and Distribution, Chapter 6 — Central Heating Plants; Chapter 7 — Compressed Air Plants; Bureau of Yards and Docks, U. S. Navy; 77 pages; illustrated; paperbound. Order PB 161358 from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Price $2.

Here is another section in the very practical, useful series of manuals on power generation and distribution prepared by the U. S. Navy Bureau of Yards and Docks and distributed by OTS in the interest of science and industry.

Chapter 6 begins with a general discussion of steam, fuels, boiler feedwater conditioning, combustion, and steam plant design factors. It gives details of feedwater heating; discusses types and operating requirements and accessories of boilers; gives considerable space to high-temperature water heating plants; covers firing equipment and pumps. It then goes on to give very practical instructions for operation and maintenance of steam and hot water boilers, stokers and coal firing, oil-fired boilers, gas burners, and heating plant auxiliaries.

It is well illustrated with very practical diagrams and sketches of procedures and equipment and should prove most useful to the men who actually operate equipment of this type.

Chapter 7 begins with a list of definitions of terms used in compressed-air work and then discusses compressed-air plant design and equipment. It covers pressure variations and load conditions, vacuum service for hospitals, and plant layout, including data on

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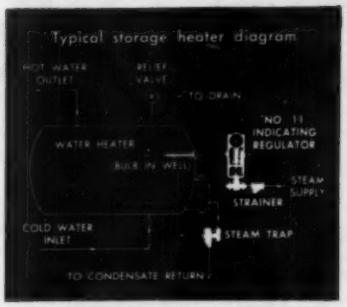

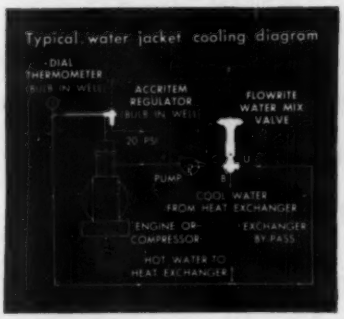

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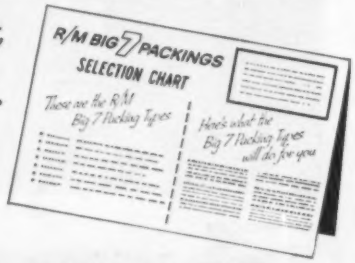

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number of compressors required, allocation, and the auxiliaries necessary.

The chapter then goes on to give details of types, sizes, drives, regulation, and circulating water for reciprocating compressors. It covers rotary compressors and blowers, centrifugal compressors and blowers, vacuum pumps, safety devices, air intakes, intercoolers and aftercoolers, receivers, instruments, piping and vacuum piping.

This is followed by very practical details on operation and maintenance of reciprocating rotary and centrifugal compressors, and a section on auxiliary equipment.

Here, again, this section on compressed-air practice is down-to-earth operating material, well illustrated with diagrams, tables of air volumes, receiver data, charts of pressure losses from pipe friction, and other data useful to men who operate compressors of all types.

★ ★ ★

Power Generation and Distribution — Chapter 8 — Electric Power Distribution; Bureau of Yards and Docks, U. S. Navy; 156 pages; illustrated; paper binding; 8½ by 11 in. Order PB 161359 from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Price $3.50.

This publication describes the components of electrical power distribution systems, including radial, ring, and network primary feeders, transformers, substations, overhead conductors, lightning arresters, ducts, direct burial, and submarine cable, switches, fuses, and voltage regulators. Also included are sections of measurement of ground resistance, radio interference, circuit breakers, batteries, and record keeping.

This chapter is very well illustrated with line diagrams of circuits, detailed pictures and diagrams of equipment, and tables of data. It gets right down into operating and maintenance details on every phase of distribution systems. For example, there is a section on Tree Trimming and Right-of-Way Maintenance. There is no discussion of electrical theory, and no mathematical treatment; but instead there is an extremely practical treatment of the use, operation, and maintenance data that must be known by men who are in charge of operating electric power distribution systems. For such men, we heartily recommend this book.

★ ★ ★

Clay Pipe Engineering Manual; 160 pages; illustrated; 6 by 9 in.; simulated leather binding. Published by Clay Products Association, Box 172, Barrington, Illinois, 1959. Price $3.

Although the price of $3 is marked in this Manual, the Association will send it without charge to engineers who write for it on their letterheads.

It is one of the most practical and useful books of its kind that we have seen. Replete with detailed illustrations, tables of sizes and capacities, and ASTM specifications, it should be of the highest value to anybody who has to design and install sewer piping and sewer systems.

It shows how to estimate future sanitary

flow, discusses the hydraulics of sewers and drains and sewer and drain layout, gives specific data on pipe strength and trench loads, and contains instructions for pipe laying and construction of appurtenances.

As noted above, ASTM specifications for clay pipe of all kinds are included. There are chapters on house sewers, vitrified clay liner plates, specifications for clay filter block, and instructions for designing municipal storm sewers and drains.

General drainage, roadway drainage, and airport and railroad track drainage are discussed; and the final chapter contains commonly used constants and tables.

Companion volume to this Manual is the Clay Pipe Handbook of Pipe Laying and Inspection. This gives detailed instructions for materials inspection and tests, excavation, laying the sewer pipe, jointing the pipe, backfilling and tamping, house connections, and final inspection. This Handbook, too, is well illustrated with details of piping and methods of doing the work, and its instructions are very detailed and practical.

We heartily recommend both these books to all engineers who have anything to do with using clay pipe.

★ ★ ★

Resources Development: Frontiers for Research, edited by Franklin S. Pollak; 315 pages; 6 by 9 in.; paperbound. Published by University of Colorado Press, Temporary Building One, University of Colorado, Boulder, Colo. Price $3.75.

This 315-page book contains 23 articles on various aspects of resource development in the Western states presented at the 1959 Western Resources Conference.

Topics discussed include: Evaluation of the West's Land Policy and Development; Atomic Energy as a Resource; Potential Applications of New Water Technology; Changing Patterns of Land Use; Better Planning of River Systems; Potential of the Western Metal Mining Industry; Opportunities for Graduate Study and Research; Need for Greater Inter-Institutional Cooperation.

Authors of the papers are important figures in resources development in the country, and they give valuable statistics on resources development and a great deal of practical information on how it can be done.

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Engineering Mathematics, by J. Blakey and M. Hutton; 603 pages, 5½ by 8½ in. Published by Philosophical Library Inc, 15 E. 40th St, New York 16, N. Y; $10.

Written by British educators, this volume is intended to cover the pure mathematics required for a degree in engineering. The first chapter provides fundamental relations from algebra, trigonometry, and co-ordinate geometry which the authors feel are essential to promote facility in problem solving. Subjects dealt with are differential and integral calculus, series, determinants, co-ordinate geometry, differential and partial differential equations, spherical trigonometry, numerical methods, statistics and the La Place transformation.

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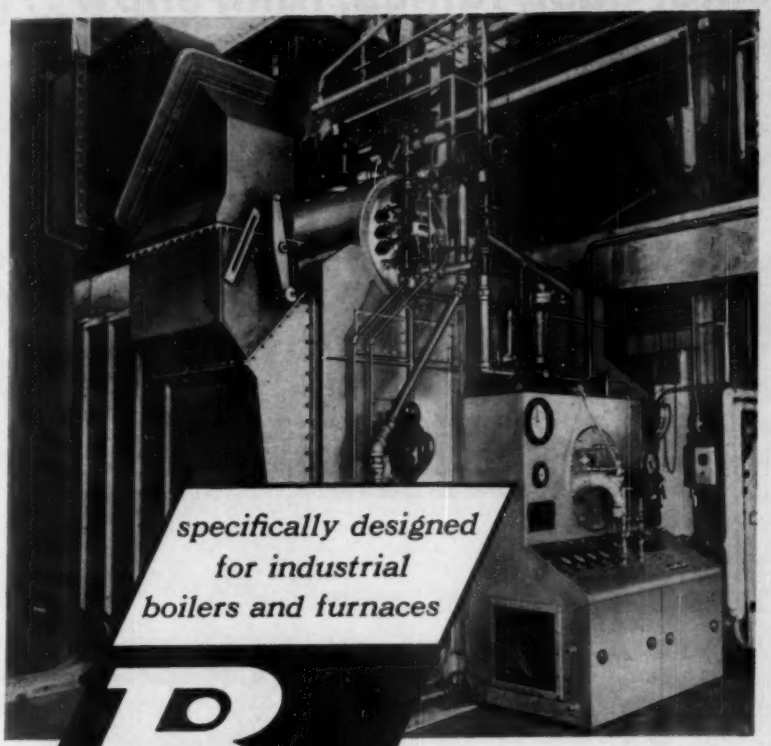

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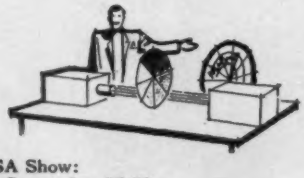

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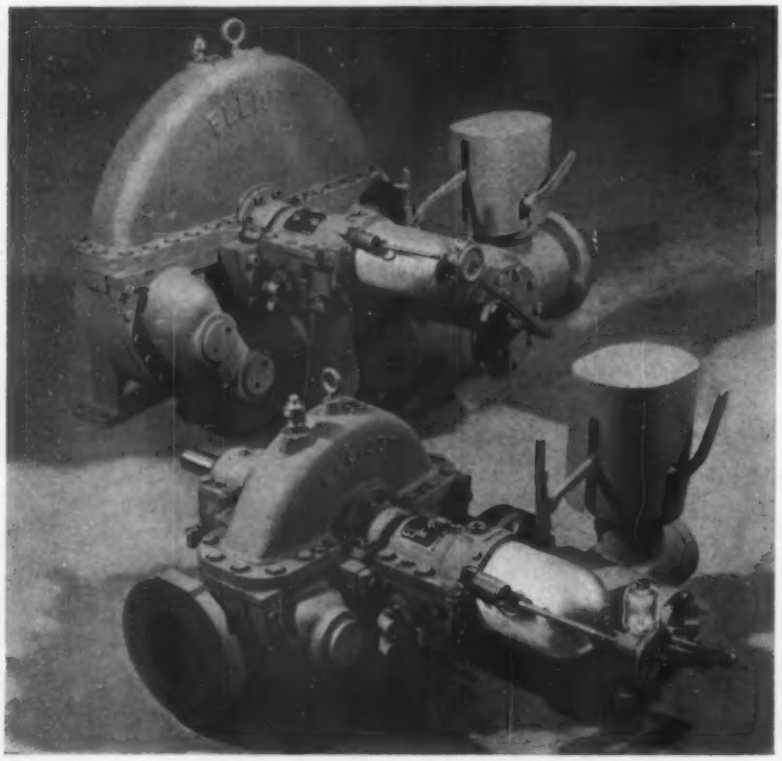

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Continued from page 77

burner nozzle operation is not considered desirable. On the other hand, lighting all four burners on one elevation simultaneously was not considered desirable either, particularly for warm-up and controlling gas temperatures to reheater. Therefore we arrived at the decision that each burner light-off switch would control a pair of diagonally opposed burner nozzles.

Each fuel and air compartment (nine per corner) was provided with an electric damper actuator. Arranged for control by elevation, the compartment dampers on any elevation can be set in any of six positions by control switches at the central panel. A single switch actuates all compartment dampers on one elevation.

Flame Detection Equipment

For flame detection we selected the type which utilizes the photoconductive reaction to infra-red emission of a lead sulfide cell. The most common difficulty encountered in applying this device is met in what is called "discrimination." The ability to discriminate is the ability to sense only the flame of the burner being monitored. One hundred per cent discrimination means that at all ratings a detection device will not be actuated by anything other than the flame issuing from the burner it monitors.

Discrimination can be a very complicated problem in a furnace with a multiplicity of burners, and in some furnace configurations it becomes impossible at higher firing rates. We had no difficulty in this respect, for it will be recalled that tangential firing permitted us to consider the entire furnace as a single burner. Thus with all burners (corners) in service at high firing rates we were not interested in ability to discriminate. Our *only* concern then was total loss of flame and this, of course, did not involve individual burner nozzle discrimination.

With this philosophy of protection as a guide, the system was arranged so that a "loss of flame" signal from all four flame detectors was required to cause a fuel trip. This fuel shutoff would occur only if the flame safeguard selector switch were in the "automatic" position. In the "manual" position, flame loss signals from all four corners sound an alarm and indicate a loss at each corner.

What does this mean in terms of day to day operation? Simply that dirty, overheated or defective flame

scanners, accidental injury to scanner leads, moisture in scanner conduits, tube failures *within* the flame safeguard device could *not* cause a fuel interruption. Component failure *within* a safeguard still causes the device to fail safe, but the failure merely sounds an alarm — it is *not* allowed to interrupt fuel flow. Only by simultaneous failure of internal components in all four corners could fuel flow be accidentally interrupted.

New Detection Systems

At this writing several newer flame detection systems have appeared in the market place. Most significant among them are the ultraviolet detection and a new method known as "Furnace ΔP protection," which provides both qualitative and quantitative flame monitoring. Both systems are accumulating operating experience, and it is hoped that application refinements will broaden their scope and usefulness.

Flame proving was also a must for the gas-electric side ignitors since it was considered essential that the ignitors be burning before admitting gas to the associated burners. Thermocouple pilot generators with sensitive relay amplification were standard ignitor flame proving devices at that time. Because of their simplicity and high order discrimination, this type was installed and interlocked with burner controls. Today Combustion has overcome the slow reaction time drawback of the thermocouple flame detector. A fan-shaped horn-like nozzle, Fig. 1, has been developed for pilot burners. When flame is present in this nozzle, a definite pressure drop exists across the horn and is sensed rapidly by a simple, reliable differential pressure switch. These detectors have been installed on the No. 5 unit at Southwestern's Arsenal Hill Power Plant and are performing quite well.

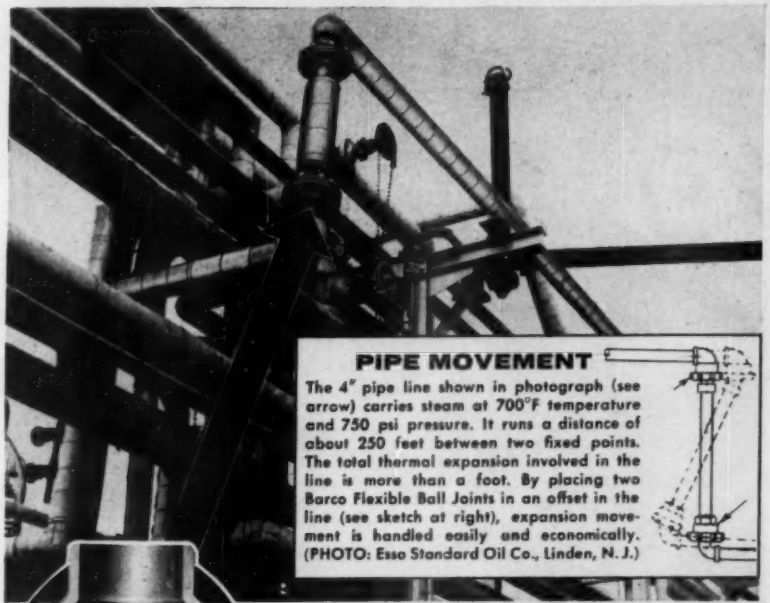
Follow These Steps

The blend of safety and availability realized in the design contributed to simplicity in operating the system. To place the burner system in service only these steps are required:

1. Power one forced-draft fan.
2. Open air compartment dampers on at least the three lower elevations. An air flow switch proves flow at 60 per cent of maximum. Note: Manual burner firing cocks *must* be proved closed during purge. Factory Mutual system, using control pressure through a valve port which is open when the valve is closed, was applied here to actuate a proving switch.

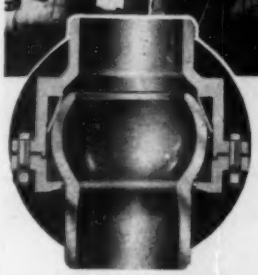
Continued on page 106

How Plant Handles 700°F. STEAM . . . PIPE EXPANSION



PIPE MOVEMENT

The 4" pipe line shown in photograph (see arrow) carries steam at 700°F temperature and 750 psi pressure. It runs a distance of about 250 feet between two fixed points. The total thermal expansion involved in the line is more than a foot. By placing two Barco Flexible Ball Joints in an offset in the line (see sketch at right), expansion movement is handled easily and economically. (PHOTO: Esso Standard Oil Co., Linden, N. J.)



BARCO HT HIGH TEMP. Flexible BALL JOINTS

SAVE VALUABLE SPACE

ADVANTAGES:

SAVE SPACE—Barco Ball Joints are used to perform functions similar to U-bends or pipe loops—But with much less space required and often LOWER COST.

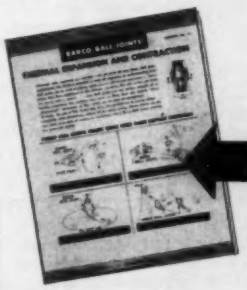
NO PRESSURE THRUST—Expensive anchoring or bracing not required to hold piping in place or in line.

HIGH TEMPERATURE, PRESSURE—Wide choice of materials in new Barco HT Joints.

SIMPLE—Easy to solve virtually any problem with aid of two or three Barco Joints.

The Barco HT (High Temperature) Flexible Ball Joint is a new development. It is *the key* to solving many PIPE EXPANSION PROBLEMS where high temperatures and pressures are encountered. The outer sealing gasket is a special, high temperature ring. The inner take up ring is self-adjusting to thermal expansion and maintains tight sealing action without building up high resistance (friction) to turning or angular flexing. HT joints can be supplied in sizes from 1" to 12", angle or straight, and can be fabricated from materials to withstand as much as 1000°F, 1200°F, or even 1400°F, under certain conditions.

Local Barco Field Engineers will be glad to give you full information and recommendations. Call or write today.



Send for this BULLETIN 31

"How to Solve Piping Flexibility Problems". Complete with piping layout drawings and illustrations. Shows how to cut costs, save time, and do a better job!

PRODUCTS BACKED BY EXPERIENCE BARCO FOUNDED 1910

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In Canada: The Holden Co., Ltd., Montreal

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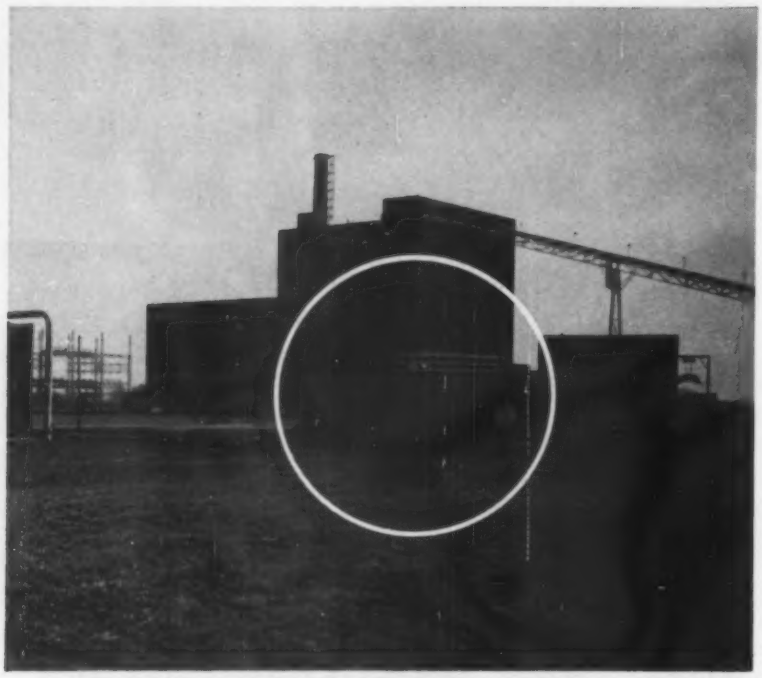
FLUIDICS* AT WORK



Permutit Precipitator treats sewage effluent to provide cooling-tower make-up water at the Municipal Electric Lighting & Power Plant, Richmond, Ind. Consulting engineers: Black & Veatch of Kansas City, Mo.

Consider sewage effluent as a second source of cooling water

Problem: This generating station needs plenty of water for its cooling tower. The river supply fluctuates. It must be augmented.

Solution: Working together, the Municipal Electric Lighting & Power Plant, Richmond, Ind., and its consulting engineers came up with a potential 7,000,000-gallon-a-day additional source: the city's sewage-plant effluent.

Now there's no question about water supply—even in the future, when the plant reaches its ultimate design capacity of 150,000 kw. Cooling-tower make-up may now come from the river, from the waste effluent, or be a mixture of both.

How? To turn sewage-plant effluent into usable cooling-tower water, you must stabilize the water and remove turbidity. Clarify, stabilize, give it the right chemical characteristics—process it in large quantities at low cost.

The Permutit Precipitator® you see in the picture above does this job. It was chosen because of its unique solids-contact features, which insure complete treatment at economical installed and operating cost.

Bulletins available: Operating details on Permutit Precipitators are contained in Bulletin 2204. Also available: "Outline of Water Treatment Equipment," Bulletin 4433, and our waste-treatment guide, Bulletin 4486. For copies, write to: Permutit Division, Dept. PE-90, 50 West 44th Street, New York 36, New York. In Canada, the Permutit Company of Canada, Ltd., 207 Queen's Quay West, Toronto, Ontario.

*FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.

PFAUDLER PERMUTIT INC.

Specialists in FLUIDICS . . . the science of fluid processes

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3. When the purge has been properly accomplished, the main gas-supply trip-valves may be opened assuming that gas supply pressure is satisfactory.

4. Using a single switch energize all four gas-electric pilots on Elevation One (lower level). Indicating lights notify the operator when ignitor flames have been proved.

5. With ignitors proved, the burner switch for burners 1A and 1C is actuated. The gas hydramotor valves for these burners open, and flame is established. Flame detectors signal proved flame to the operator through indicating lights on the control panel. As a double check the television screen is observed when lighting burners.

6. With the flame safeguard system satisfied firing cocks for burners 1B and 1D are opened and the burner control switch governing these two burners is actuated.

7. Additional levels are placed in service in the same manner, working from the lower levels upward.

With the flame safeguard system switch on the "manual" position total furnace blackout will result only in alarm and signal light indication. Main fuel shutoff valves do not trip. This unit was operated for approximately two years principally on *manual* flame safeguard supervision until the reliability of flame detectors was established to the satisfaction of all concerned. The "automatic" type of operation has been used for more than a year for total flame failure protection.

Unique Feature

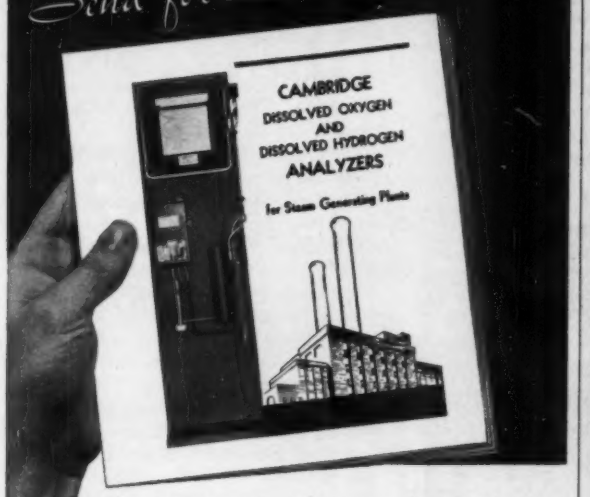
A rather unique feature of this arrangement removes the side ignitor interlock when the main burner valve is 80 per cent open. This valve opening corresponds to 95 per cent flow through the valve. The ignitor must be lit and proved before fuel flow can be established in the main burner, but once it is established the ignitor interlock is no longer functional. Also, any ignitor may be de-energized locally at its individual control cabinet for maintenance without causing a trip of its associated gas main burners. On the other hand, if all ignitors on a given elevation are de-energized from the ignitor switch in the control room, all main gas burner hydramotor valves on that level will also trip.

Development of Equipment

A great deal of work has been done by a number of interested component manufacturers and we have seen a material advancement in component quality in recent years.

Concluded on page 108

Send for BULLETIN 148-BP



Continuous records of the oxygen dissolved in boiling feed water and of the hydrogen entrained in steam, point to the corrective measures necessary to prevent otherwise unsuspected and costly corrosion. The Cambridge Analyzers measure and record dissolved oxygen directly. The hydrogen in the steam is measure of the oxygen set free by dissociation. Cambridge Instruments are available for recording O^2 and H^2 either separately or simultaneously.

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CAMBRIDGE INSTRUMENT CO., INC.

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ELLISON
Inclined Tube
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give you features that assure accuracy and long service life!

LARGE oil chamber with expansion compensating system. Constant zero (no oil in tube over scale at zero). Level and tube replaceable in field. Coreprene tube packing. Easy reading scales. Over 50 sizes. Wide range of scale lengths, ranges and increments, including 30" scale reading up to 10" of water, in .05" increments. The Ellison line includes both stationary and portable inclined tube draft gages — regular and laboratory type. Also pitot tubes and compact gage sets. Send for Bulletin 109-D.

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Draft Gages, Bell and Diafram — Inclined Draft Gages — Portable Inclined Vertical Tube Gages — Vertical Tube Gages, Oil, Heavy Liquid and Mercury, Single and Multi-Tube — U-Gages, Stationary and Portable — Air Filter Gages, Dial and Inclined Tube Types — Pitot Tubes — U-Path Steam Calorimeters — Portable Gas Analyzers, Orsat Type — Alarm Systems — Orifice Flanges and Orifice Plates — Flow Tube Meters — Condensate Traps.

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PROVED IN USE FOR SUPERIOR QUALITY, DEPENDABILITY AND SAFETY . . .

Whether you count the hours, the days, or the years, world-wide industry has counted on NORWALK as the reliable source of compressors that fulfill every specification: from single stage to six stages; from 125 to 42,000 PSI pressure; for a full range of gases: Acetylene, Air, Argon, Specific Hydro Carbons, CO and CO_2, Ethane, Ethylene, HCl, Helium, Hydrogen, Nitrogen, Nitrous Oxide, Oxygen.

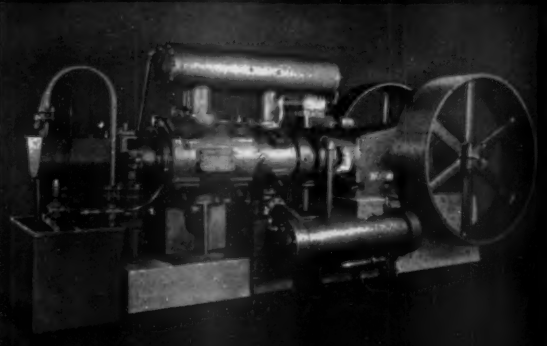
NORWALK

HIGH PRESSURE AIR and GAS

COMPRESSORS

ALMOST 100 YEARS

CONTINUOUS SERVICE
CUSTOM FABRICATING
THE WORLD'S FINEST
COMPRESSORS FOR
EVERY INDUSTRY . . .
FOR EVERY PURPOSE.



Phone TEmple 8-4766 in South Norwalk for immediate consultation of your inquiry. Write, for informative, descriptive Catalog 1960.

NORWALK
COMPANY, INC.
SOUTH NORWALK, CONNECTICUT

COMPRESSOR SPECIALISTS TO WORLD WIDE INDUSTRY SINCE 1864

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We feel that there is still much to be done and are equally confident that it *will* be done and soon. The demands for fully automatic systems which will not have an operator to close the loop are accelerating the improvement of components to a degree never before seen.

Systems had to be proved for remote-manual service before remote automatic could even be considered. The major difficulty of course will be replacing the decision-making ability of the operator. To achieve this goal successfully it will be necessary to pre-think out the proper reaction to innumerable operating contingencies. None can be overlooked safely.

Operating and system building experience gained at installations like Lieberman will prove invaluable in planning tomorrow's systems. These experiences encourage advancement by indicating some of the benefits to be gained from remote firing. They also furnish a store of knowledge as a basis for development in the future. THE END

Acknowledgements

The authors wish to acknowledge with thanks the assistance of at least a few of the Southwestern Electric Power Company personnel whose cooperation and encouragement helped make this installation a success. Among them are R. W. Dodson and R. S. Moncrief.

FORCED DRAFT—REGISTER TYPE PACKAGED BURNER SYSTEM

FULLY AUTOMATIC OR SEMI-AUTOMATIC . . . this high efficiency system is manufactured in a wide variety of sizes and models, arranged for firing steam boilers and high temperature hot water generators of all types up to the equivalent of 100,000 lbs. of steam per hour. Available with axial flow blowers or centrifugal blowers fitted with electric motor or steam turbine drive as required.

"SAV-PAC" is built for trouble-free performance, extra economy using all grades of fuel oils, gaseous fuels or combinations of both. Self-contained unit includes register-type burner, forced draft fan, air-fuel controls, wiring and piping in separate enclosed panels, mounted complete.

Also available TODD ROTO-PAC *fully automatic forced draft rotary burner systems.*

Write for complete details and specifications

TODD SHIPYARDS CORPORATION
PRODUCTS DIVISION

Sales and Service Departments: Columbia and Halleck Sts., Brooklyn 31, N. Y.
Plant, Sales and Service: P. O. Box 9666, Houston, Texas

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NBBB Pushes Accurate Rating System in Air Conditioning

NBBB STATES that some package air conditioners have been advertised claiming Btu ratings substantially greater than the ratings of the units based on the NEMA or ARI Standards. These inflated ratings are obtained by various unorthodox procedures. Claims based on these procedures imply that the units so advertised possess superior cooling capacity, but comparably exaggerated ratings could be shown for units of other manufacturers if the same procedures were applied.

Only recognized method of stating cooling capacity accurately is in terms of Btu's per hour. However, the amount of heat — that is the number of Btu's which a given air-conditioning unit will remove from the air — depends upon both the temperature and moisture content of the air. Thus, the measured Btu-per-hour capacity of the unit will vary with the temperature and humidity of the air in which the equipment is tested.

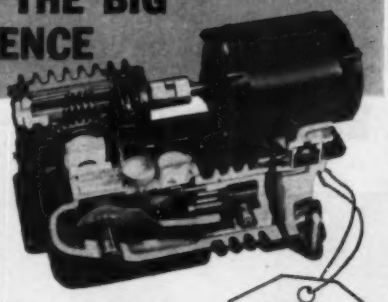
In order to provide a reasonable and uniform test basis which provides a standard yardstick for comparison, the American Society of Heating, Refrigeration and Air-Conditioning Engineers developed its Standards 16–53. The test methods of 16–53 have been incorporated into both NEMA Standard CN 1-1958 and ARI Standard 110–58.

Only by expressing all claims for cooling capacity in terms of Btu-per-hour capacity of the unit according to its rating based on the NEMA Standard or the ARI Standard can advertisers eliminate the confusion which has appeared in much advertising of room air conditioners in the past.

There are fundamental objections to expressing cooling capacity of room air conditioners by other methods such as "ton," "horsepower," or ratings based on unorthodox test procedures, and the use of such methods has the capacity and tendency to confuse or deceive the public. Although advertising claims based on these methods are no longer in general use, they still recur in isolated cases.

NBBB recommends that use of the word "ton" be avoided in advertising the cooling capacity of room air conditioners, unless that word accurately expresses the Btu rating of the unit so described. Also, the term "horsepower" has proved equally unsatisfactory as a means of expressing cooling capacity.

UNITIZED CONSTRUCTION MAKES THE BIG DIFFERENCE



Unitized construction means it's completely enclosed, locked in permanent alignment, sealed against leakage, dirt and weather. All moving parts inside run in oil. Heavy duty design includes machine cut gears, outboard bearings on pump drive shaft. Solution heads of special materials available for slurries, corrosive liquids. Four standard sizes, up to 54 GPH, pressures to 300 psi. Duplex units double the capacity with one motor.

in the new **MADDEN** *Metriflow* **METERING PUMP**

Write for complete information on the new Madden METRIFLOW Metering Pump

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The easiest—and quickest—way to order bulletins and catalogs described in this magazine is to use the postage-free Reader Service Cards on pages 113–114.

All you need to do is circle the item numbers of those you want. Then fill in your name, job title, company name and address—and mail the card.

You may also use the Reader Service Cards to request information on products described, or literature mentioned in the ads—just circle the number below the ad.

1

First...for continuous, efficient pH control

to prevent costly corrosion and scale deposition...modern steam power plants rely upon *one* name...the *leader* in development and production of *advanced* pH instrumentation for 25 years **Beckman**

Scientific and Process Instruments Division
Beckman Instruments, Inc.
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INSTRUMENTAL IN YOUR FUTURE · 25 YEARS · 1935-1960

Beckman pH sales and service is foremost in North America—3 strategic parts locations—electrodes available from more than 100 scientific apparatus dealers—field engineering in over 300 branches of leading recorder companies. Write for Data File 78-9-06.

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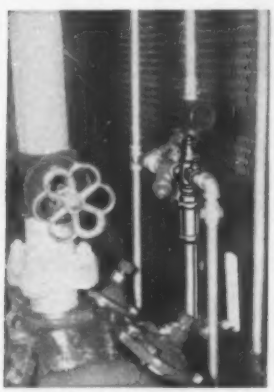
SARCO TOPICS

How to save water and prevent over-cooling of compressors, small engines, and hydraulic oil-coolers

When cooling water is controlled manually the operator frequently leaves the valve nearly wide open, in order to play safe if the load varies. The result is over-cooling. If he attempts to vary the flow of water he risks the danger of under-cooling. Automatic cooling controls assure proper cooling at *all* times and effect important economies in water consumption.

And here are three different experiences at Revere Copper and Brass plants which may give you some tips on solving your own cooling control problems.

How Revere Copper & Brass Saved over 50% on water



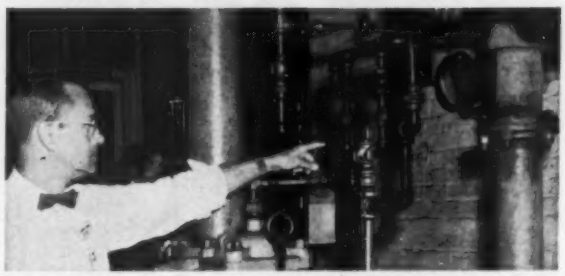
Sarco T-44 automatic cooling control installed at Revere's Riverside plant.

The Riverside, California, plant of Revere Copper & Brass was plagued by over-cooling of compressors. In addition, their water consumption was high — approximately 2,000 gallons an hour. By simply installing Sarco T-44 automatic cooling controls on the compressor cooling lines, plant engineers eliminated over-cooling and cut water consumption about 60%.

Another benefit was a saving in tool maintenance. (Originally excess moisture was causing difficulty with a large number of air screwdrivers used in the plant.) With the T-44's in service the maintenance problem has practically disappeared.

Manual control was wasting water at Rome Manufacturing Co. Div., Rome, N. Y.

At the Rome Manufacturing Company Division of Revere, at Rome, N. Y., cooling water for air compressors originally was manually controlled. When they installed Sarco T-44 automatic cooling controls on the cooling water lines they made substantial savings in water. They saved damage and maintenance cost on the compressors, too. That's because they eliminated the errors inherent in manual control. Automatic cooling controls always assure optimum cooling by permitting safe operation at the maximum temperature recommended for any given machine or process.



T-44 cooling control on compressor at Rome Manufacturing Co. Div. of Revere. Sarco sales representative Emile Strickland points to control installations.

Installation of a Sarco T-44 on compressor at Rome, N. Y.

Water conservation program at Baltimore led to automatic control

Double target of engineers at the Baltimore plant of Revere was a water conservation program plus tighter temperature control. To achieve both objectives they installed Sarco automatic cooling controls on an air compressor, an aftercooler and a hydraulic oil cooler.

Results were so satisfactory they followed through by installing 50 additional Sarco controls.

For more information on cooling control, contact your Sarco Sales Representative, District office, or write — 2169

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SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.

STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES

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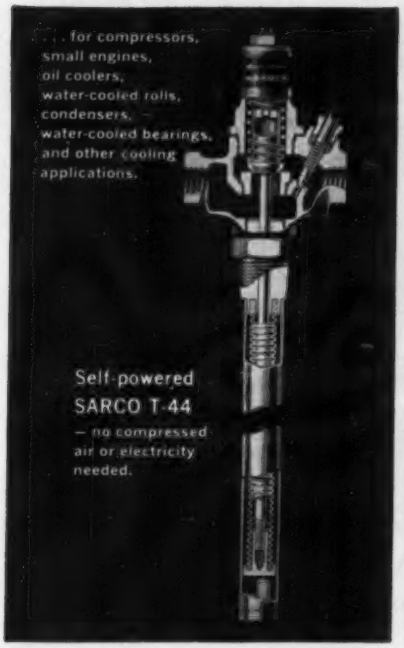
SARCO

Inside story on automatic cooling control


. . . for compressors, small engines, oil coolers, water-cooled rolls, condensers, water-cooled bearings, and other cooling applications.
Self-powered SARCO T-44
— no compressed air or electricity needed.

Simple, gadget-free design. Fully modulating. Sensitive liquid-filled thermostat gives you uniform movement of valve for each degree of temperature change, at all points on the range. Packless — no stuffing box — no leaks — no valve stem jamming. Self-contained — no part of mechanism exposed. Dependable and inexpensive — thousands in service. So reasonable in cost, you can afford Sarco automatic cooling controls for every application.

Sarco T-44 self-powered cooling control is available in standard 50° adjustment ranges: 60-110° F., 85-135° F., 110-160° F. and 135-185° F. Sizes: ⅜", ¾", ½" and 1".

For the full story on Sarco Cooling Controls...

contact your Sarco sales representative or district office, or write—

2168

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SARCO COMPANY, INC.
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FPC NEWS

» **Each month,** POWER ENGINEERING receives many reports about the activities of the Federal Power Commission and the utilities and industries governed mainly by its decisions. To give some idea of the magnitude of new facilities planned, in the gas and electric field, we present here in digested form some of the more significant reports that have recently come across our desk.

» **Six applications** made by four interstate natural gas pipeline companies were approved in a decision filed on July 22 by FPC Presiding Examiner Emery J. Woodall. The action relates generally to an expansion of the pipeline system of Texas Eastern Transmission Corp, of Shreveport, La. Other companies affected by the decision are Algonquin Gas Transmission Co, of Boston, Mass.; Transcontinental Gas Pipe Line Corp, of Houston, Texas; and New York State Natural Gas Corp, of Pittsburgh, Penna.

Project will provide a new winter natural gas service to 23 of Texas Eastern's wholesale customers in the Midwest and East, and will make available to them a total maximum capacity of 334,036,000 cu ft per day.

Texas Eastern will construct 214 miles of 20- to 36-in. pipeline and 3300-hp compressor stations in Pennsylvania, New Jersey, and New York, all at an approximate cost of $40,668,000. TE will jointly develop, with Transcontinental and New York Natural, its share of the Leidy Storage Field, which overlaps three Pennsylvania counties; investment: an estimated $8,022,400.

Algonquin is authorized to build 30 miles of pipeline and 8000 hp in compressor capacity in Massachusetts at a cost of $5,502,200. Transportation and sale of 75,130,000 cu ft of winter service gas will result.

Transcontinental was authorized to construct a $2,995,000, 6000-hp compressor station in Pennsylvania to enable it to fulfill its delivery obligations in the storage area after TE's share of the Leidy Field is developed.

» **In a recent action,** the FPC authorized Texas Gas Transmission Corp, of Owensboro, Ky, to develop the West Greenville gas field in Muhlenberg County, Ky, as an underground natural gas reservoir. Total cost of the project will reach $3,561,500 after rights and interests to the field have been purchased from Western Kentucky Gas Co, also of Owensboro.

Cost of the proposed facilities will be about $2,506,000. Items include 29.5 miles of 12-in. pipeline from the West Greenville field to its main line facilities near Slaughters, Ky; a 1760-hp compressor station; dehydration plant; and a meter station. Texas Gas will ultimately develop the storage pool to peak-day deliverability of about 35,000,000 cubic feet.

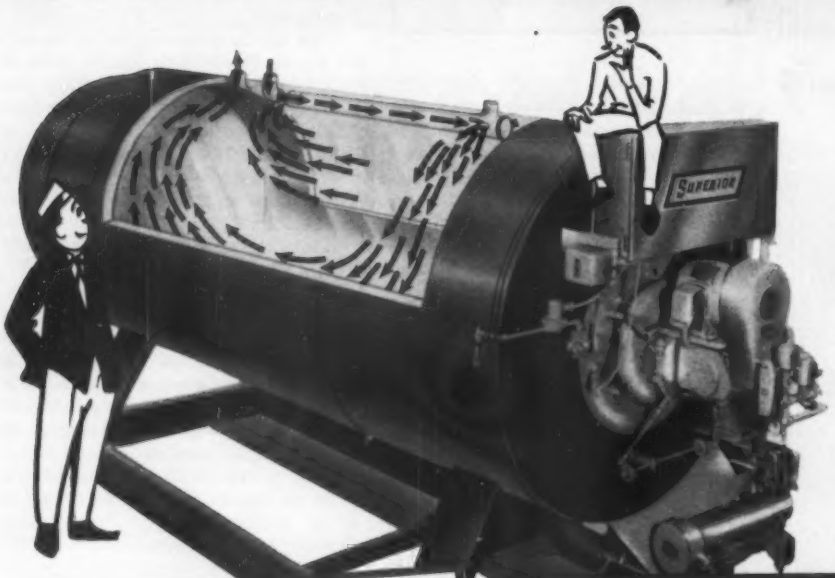
» **El Paso Natural Gas Co** was granted temporary authorization to install an additional 6800 hp at its Goldsmith compressor station, and facilities to provide an additional 58,800,000 cu ft per day capacity at its Goldsmith purification and dehydration plant. Cost of construction is an estimated $3,930,000. Location is in Ector County, Texas, near Odessa. Additional facilities will provide the station with a total capacity of approximately 270,000,000 cu ft of gas daily.

» **Mountain Fuel Supply Co,** of Salt Lake City, Utah, also was granted a temporary authorization in a recent FPC action. The firm proposes to build about 20 miles of 20-in. loop line and a 2640-hp compressor station. Included in the project will be replacement of 6.74 miles of 16-in. line with 24-in. pipe, and 6.36 miles of 18-in. line with 20-in. pipe. Construction cost is an estimated $3,125,000. Facilities will thus raise interstate pipeline capacity 240,770,000 to 260,410,000 cu ft daily.

» **In an announcement** made on July 21, the Federal Power Commission revealed that it had given temporary authority to Transwestern Pipeline Co, of Houston, Texas, to construct and operate natural gas facilities costing approximately $8,701,980.

This action will allow Transwestern to construct about 250 miles of gathering lines of varying diameter; three new compressor stations, having a combined capacity of 8040 hp; and appurtenant equipment. The new facilities will enable Transwestern to take into its main pipeline system natural gas purchased from independent producers in the same areas in which it is now purchasing gas, which are coextensive with its system in west Texas and the Anadarko Basin areas of Texas and Oklahoma.

look what's happened to hot water boilers!



No, we're not making them with windows . . . we did that in the illustration to show you our NEW Venturi-action Mixing Tube which is the talk of the industry.

Venturi-Action Mixing Tube plays a triple role:

1 It starts by mixing entrained water from the boiler with water entering the boiler.

2 Traveling through the tube, the temperature is further modified by the surrounding water.

3 Jet action at the end of the tube directs flow downward and outward against the outer confines of the shell, providing a circulation pattern unequalled in any other hot water boiler.

SUPERIOR "TYPE CC"

For details of Superior's Hot Water Boilers in sizes to 350 BHP write for catalog CCW-12. For sizes from 400 to 600 BHP write for catalog CFW-12.

Simple as it is, the importance of this NEW Venturi-action Mixing Tube can hardly be over-emphasized; for hot water boilers in many types of installations are subjected to rapid and extreme changes of water temperature. When the distribution of cool water is not completely equalized, the resulting expansion and contraction of the boiler causes stresses and strains which have become known as Thermal Shock.

No hot water boiler can be made to withstand severe and repeated Thermal Shock . . . but this new Superior Boiler is designed to reduce it to a minimum.

Available in sizes to 600 BHP, Superior's Hot Water Boiler is the answer to trouble-free hot water heating.

Specialists in PACKAGED BOILERS . . . exclusively

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SUPERIOR PACKAGED BOILERS

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Current Catalogs

continued from page 30

157 Turbine Type Blowers — Bulletin 142C describes The Spencer Turbine Co.'s turbine type blowers for sewage treatment and other agitation applications in chemical, food processing and other fields. Includes installation photos and application data, typical job specifications.

158 Air Handling Unit — Featured in this product bulletin of The King Co. of Owatonna is an industrial ventilating, heating and conditioning unit for use in a variety of industries. Typical installations are given, as well as physical data and specifications.

159 Industrial Ventilators — This 20-pp guide for better air control, released by The Loren Cook Co., is designed to help determine type of ventilation equipment for specific needs. The guide matches design features with ventilation requirements and special conditions, controlling efficiency, and economy, and includes performance and dimension charts.

160 Heating, Ventilating Units — Illustrated and described in this 24-pp bulletin, by McQuay, Inc., is the Seasonvent line of heating and ventilating units. Includes detailed information on sizes, capacities, applications, together with dimensional and arrangement data and engineering specifications.

161 Packaged Air Conditioner — Detailed information on packaged air conditioners of Dunham-Bush, Inc., is presented in 12-pp Bulletin 6022. Cutaway view shows component features and tables list capacity data, specifications.

162 Centrifugal Fan Towers — Bulletin ECKB-601, Halstead & Mitchell Co., describes centrifugal fan cooling towers designed for indoor installations requiring ductwork. Table of operating and dimensional data included.

Other Equipment

163 Thermal Insulation — Bulletin J-661 of Baldwin-Ehret-Hill, Inc., describes thermal and acoustical characteristics of an insulating material made of incombustible moisture resistant mineral fibers with small amount of thermo-setting resin binder.

164 Engine Oil — Technical Bulletin describes characteristics and advantages of Sun Oil Co.'s two-cycle engine oil for use where lubricating oil is mixed with fuel to power chain saws, pumps, generators, railroad motor cars, etc. Specifications and performance data included.

When ordering catalogs don't forget that the Reader Service Cards can also be used to request any literature offered in the ads

165 Building Maintenance — This 28-pp manual offered by S. C. Johnson & Son, Inc. provides detailed information on modern methods and materials for building maintenance. Includes section on clean-

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ing and finishing floors and a chart explains characteristics of 12 different floor surfaces. Other sections deal with general cleaning and maintenance.

166 **Scaffold Hoist** — Features and advantages of the Skyclimber which climbs the wire rather than spooling wire on drum are detailed by Western Gear Corp. in Bulletin 5909. Describes convertibility feature from manual, to air-powered to electric-powered operation.

. . . *Outstanding Among This Month's Catalogs*

167 **Fire Protection Equipment** — Power plant fire protection systems are described in this 6-pp bulletin released by Cardox Div., Chemetron Corp. Describes protection for generators and supplementary equipment, as well as generator purging and coal bunker inerting.

168 **Elevator Rope Guide** — When elevator rope should be retired, lubrication, safety factors, diagrams, and specifications are covered in Elevator Wire Rope Book E-10 of Macwhyte Wire Rope Co It is of particular interest to power engineers concerned with repair and maintenance of passenger and freight elevators.

169 **Packing Chart** — This packing recommendation chart by Raybestos-Manhattan, Inc., shows proper packing types for specific applications. The chart suggests seven basic packing types for 95 per cent of all packing needs, including such applications as: pumps and valves, high-temperature valve stem and expansion joints, high-speed rotary air compressors, corrosive and viscous liquids, chemicals, gasket applications, and hydraulic and pneumatic equipment.

170 **Screw Conveyor Drives** — Bulletin 7106 presents 20 pp of data on screw conveyor drives of The Falk Corp. available for applications in range from ¾ to 30 hp, in four ratios, designed to bolt to standard trough ends. Design features and accessories are described, and selection and dimensional data included.

171 **Dust Collector** — Operating principle and construction features of a reverse jet fabric dust collector made by American Air Filter Co., Inc., are detailed in 8-pp Bulletin 279C. Includes application and size data and a convenient selection nomograph.

172 **Steel Weight Tables** — This 72-pp booklet, released by Jos. Dyson & Sons, Inc., contains weight tables of steel, including weights of round, square, hexagon, octagon, and flat steel bars in a wide range of thicknesses. Also includes decimal equivalents, tables of area and circumferences of circles, and other formulas.

173 **For Bar Screen Cleaning** — Instrumentation Data Sheet 9.7-1, released by Minneapolis-Honeywell Regulator Co., explains various control systems used to clean bar screens automatically with the differential method. Application data and guide specifications included.

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Equipment News

Described on these pages are new and improved products. Use Reader Service Cards on pages 113–114 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

1—Power-rotated jib crane handles loads to 20 tons

Development of this extra-heavy capacity unit with low mounting space requirements, by R. C. Le Tourneau, Inc., is attributed to use of a new high-strength alloy steel produced by company's steel division. The crane is de-

signed to permit one-man handling of heavy castings and forgings, machine tools, power units, steel slabs. It is available with jib spans up to 25 ft, and with vertical clearances to 25 ft. Pillar mount type column is 27 by 27 in. All-weather design makes this crane suitable for outdoor installation, it is noted, and although intended for operation with manufacturer's 20-ton power trolley electric hoist, it can be used with other hoists with standard trolley mounting. Power for 360-deg rotation in either direction with full capacity loads is provided by a high-torque a-c electric motor. A feature of the unit is precision load spotting control.

3—Descaler cleans, dissolves scale, is non-corroding

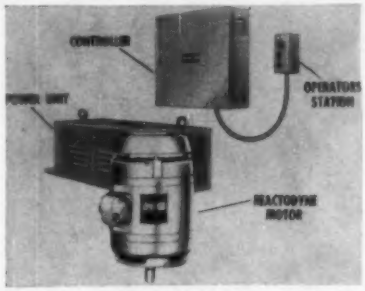
Scale-Cleen, a sulfamic acid descaler with inhibitors, is announced by Dearborn Chemical Co. for cleaning and dissolving scale without corroding or damaging metal. A built-in color indicator shows when the acid has been spent. Scale-Cleen (95 per cent acid) is suggested for acid cleaning of boilers, air conditioners, heaters, evaporators, heat exchangers, steam generators, diesel cooling systems, etc. It is described as a dry crystalline material (a spill is simply shoveled up), without irritating fumes, and non-irritating to the skin. When dissolved in water the descaler becomes a strong mineral acid which incorporates an action-speeding agent.

4—Recloser bypass structure comes as complete package

For the low-voltage side of a 15-kv distribution substation, this structure, announced by Westinghouse Electric Corp., includes a PR recloser with draw-out contacts for disconnecting, bypass devices, lightning arresters and provisions for instrument transformers. It can serve as a dead-end structure for outgoing feeders since it is capable of 4000-lb loading. Structural members are lightweight aluminum. The structure is shipped in two sections. To complete assembly, the upper section is bolted to the lower, and control and metering wiring installed. Copper-tube bus is insulated with plastic sleeves to 110-kv BIL, and will handle 600 amp continuously. Bypass devices can be disconnect switches, fuse cutouts, or power fuses. Low-voltage lightning arresters are mounted on the outgoing bus.

5—Variable speed control for pump and fan drive

Reactodyne, a controlled speed system for centrifugal pump and fan drives, which provides variable speeds from all-electric induction motors, is a development of U. S. Electrical Motors Inc. In most applications, the system will be used where it is desirable to automatically control pump and/or fan speeds, this being accomplished by means of a signal from a small potentiometer actuated by liquid level, temperatures, pressure etc. The drive system is designed for use on "cubic" loads (heat exchanger fans and sewage pumps) where torque requirements fall off rapidly at lower

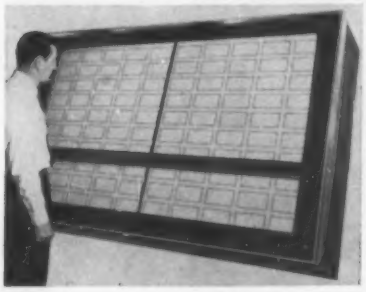


speeds. Use is not intended on constant torque loads. The drive is designed to operate from a standard 220/440-v, 60-cycle a-c power supply. Drive motors are available in horizontal or vertical types in open design.

Manufacturer points out that no moving parts are contained in the design of this control. Operator's station can be set remotely from the drive. In an emergency where continuous operation is mandatory, the control system may be by-passed and motor operated at maximum speed by connecting directly to plant a-c supply line. Ratings are from 1 to 30 hp with a 2:1 speed variation.

2—Multiple recorder makes up to 400 analog recordings

The K-Logger, a multiple recorder and annunciator, records and displays, on one chart, all variables in a process. A product of Keinath Instrument Co., it is a miniature graphic panel in its own right. Concentrating accumulation and display of process data into one unit allows control rooms and instrument panels to be smaller — enabling an operator to watch, from one spot, all aspects of a process operation. The K-Logger makes from 10 to 400 analog recordings, at rates up to 10 points per second, in 4-by-6 in. chart frames printed in columns and rows on one large sheet of paper. Each frame has an independent calibration and both pneumatic and electric signals (including thermocouples) can be mixed on one recorder.



The large chart, up to 4-by-6 ft, is held against a translucent platen, or printing surface. Fluorescent lights behind the platen provide soft illumination. Transparent process symbols of colored plastic film are applied to the platen and show through to form a graphic panel with full color-coding. Recorded traces are continuous lines of dots, printed by electrically operated printers. Traces can be printed in four different colors for easy identification of related variables plotted on the same chart frame. After removal from the K-Logger, the chart becomes a log sheet with records plotted as curves on graphs. Annunciator contacts are provided on each chart frame, with alarm lights behind the platen, so they also appear in color, or flashing sequence, superimposed on the chart frame where the off-normal variable is recorded.

6—Condenser cleaner for the small, lightly scaled tubes

Model CC-425 is a lightweight condenser tube cleaner designed by The Airetool Mfg. Co. for use in small, lightly scaled tubes up to 1 in. diam. The 4½ lb cleaner is designed for one-man operation; it operates on 90 psi at 2200 rpm. Built-in flushing system, controlled by a brass thumb valve, keeps drill head cool and removes cuttings.

7—Lubricating oil filtering system requires little maintenance

This packaged lubricating oil filtering system for use with steam turbine installations is announced by Wm. W. Nugent & Co., Inc. Capacities range from 40 to 2000 gph. The system in-

Power for Toquepala

...an example of global engineering by Brown Boveri

BROWN BOVERI

Today American free enterprise is finding opportunities all over the world. And wherever in the world these opportunities are to be found, chances are Brown Boveri is there already with factory-trained specialists, company-owned production and service facilities and the precious advantage of local know-how and engineering experience.

In planning the gigantic Toquepala project, the combine headed by American Smelting and Refining Company and its consulting engineers, Stearns-Roger Mfg. Company, turned naturally to Brown Boveri for the power supply. In Peru, nearly all large turbo-sets are Brown Boveri-built and our company there is an established service organization with resident engineers available anywhere in the country.

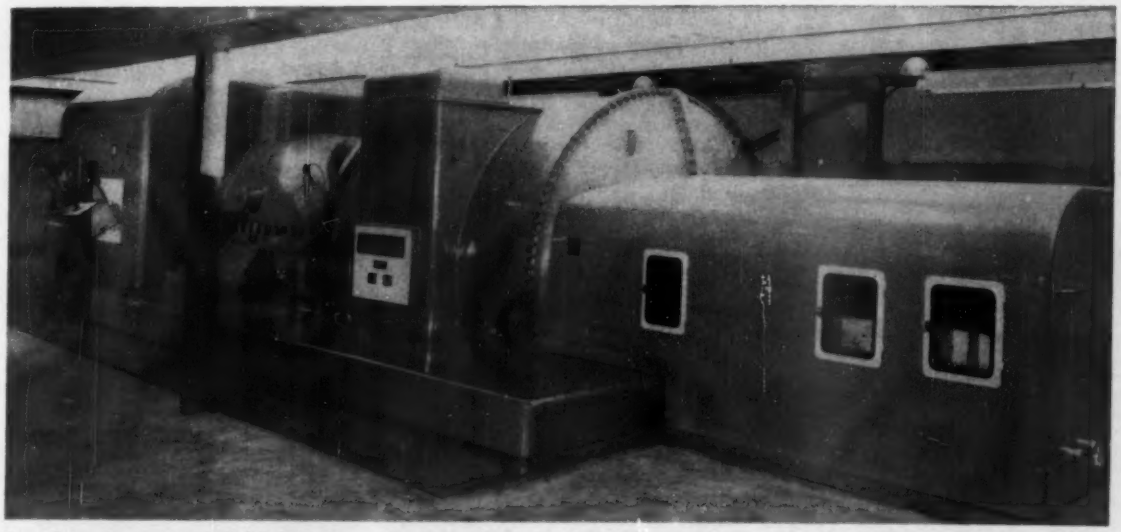
Look where you will the story is the same – be it gas turbines in Arabia, rectifiers in Rhodesia, switchgear in India, a turbo-compressor in Pakistan, power line communications in the Congo or mining operations in Arizona or Toquepala–it's routine for Brown Boveri.

Control panel for one of the Brown Boveri turbine-generators.

Over 80% of the production of Brown Boveri's great Swiss works is exported and we maintain production facilities, sales and engineering offices in over 65 countries with close to 70,000 people on our payroll.

If you are thinking of an overseas project of any kind, we invite you to draw on this unique experience in global engineering. We think you'll be glad you did.

Brown Boveri builds steam and gas turbines, boilers, condensers, generators, transformers, switchgear, rectifiers, motors and complete rolling mill drives, compressors, electric furnaces, betatrons, induction heating equipment, communication equipment.



One of two Brown Boveri 20/22 MW Preferred Standard steam turbine-generators at Toquepala copper smelter in the Peruvian Andes. Generators are 60 cycle, 3600 rpm.

They power huge electric stripping shovels, smelter blowers, crushers, separators and other heavy mill equipment . . . and two company housing projects.

This is the biggest thermal station in Peru. Brown Boveri also supplied the two main condensers, the dump condenser and the air ejectors.

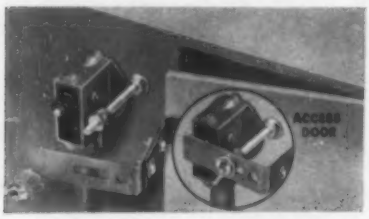
BROWN BOVERI Brown Boveri Corp., Dept. PE9, 19 Rector Street, New York 6, N. Y. Agents in 27 U. S. cities.

For more data circle 559 on Post Card

corporates automatic control and indicating accessories to report malfunctions to a distant control station. Units require only periodic maintenance. Bulletin 14F gives details.

8—Safety switch designed for use on access doors

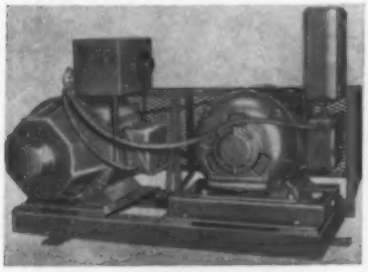
Model S911 is a safety switch designed by CRS Industries, Inc. for use on access doors leading to plenums in air conditioning systems or other chambers where there is danger of shock to personnel. Before access door can be opened a wing nut must be manually unscrewed. This unlocking operation immediately



interrupts primary power from generator thus preventing resumption of power should door blow closed after man has entered chamber. Switch cannot be locked ON with access door open, thus requiring second man at switch if high voltage equipment is to be checked.

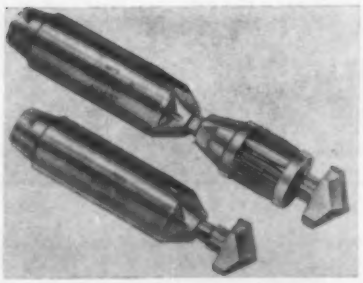
9—Alternators produce 360 to 3300 cycle range

For economical high-cycle current beyond the practical range of frequency converters, this line of high-frequency motor alternators of the Industrial Motor Div., Robbins & Myers, Inc. includes nine basic models from 1 to 7.5 kva and producing 360 to 3300



cycles. The assembly features a high-frequency alternator; a silicon rectifier unit with time-delay fuses for field excitation; and a drive motor, all on a welded steel base, with removable guard and sliding alternator base. Revolving field construction is used in ratings of 1500 cycles and lower; a brushless inductor type is supplied for ratings over 1500 to accommodate higher speeds.

Without a regulator, voltage change varies from no-load to full-load by 12 to 18 per cent, depending on rating involved. An automatic magnetic amplifier can be had to hold variation within ± 2 per cent where required. Sets usually have a pulley system matched to the desired output frequency, but in applications where several frequency changes are anticipated, variable pitch pulleys or variable speed drives with electric hydraulic, pneumatic or manual control, can be furnished.



10—Boiler preheater tube cleaner designed to save time

Rotojet, a cleaner for boiler preheater tubes, developed by Elliott Co., Roto Plant, consists of an air- or water-driven motor, sliding-pin expanding head, and a carbide drill point. For some applications the expanding head can be eliminated. Because the motor of the Rotojet is attached to a flexible hose, little headroom is required, and the tool can be fed through the length of each tube without stopping, company reports. This tool eliminates multiple lengths of rigid sectional shafting and joining of additional sections as the drill advances in the tube.

11—Synthetic belting resists oil and grease

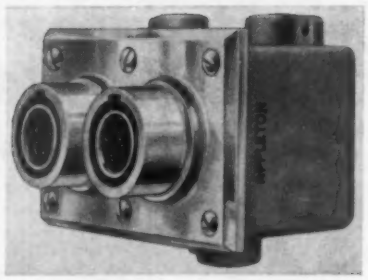
Suplex is an all-synthetic flat belt designed by R & J Dick Co., Inc. to retain its coefficient of friction, even when large quantities of oil or grease are present. The belting is an oil-resistant version of company's plastic belting and said to feature freedom from stretch, high strength and durability. According to company, it can be readily joined by a simple heat sealing method.

12—Coagulant aids promote efficient solids removal

Aquafloc coagulant aids, announced by Dearborn Chemical Co., are introduced for efficient removal of suspended and precipitated solids from water in sedimentation tanks, clarifiers, softeners or filters. They cause individual particles in water to gather in dense flocks. As these solids gather into larger, heavier masses, they settle faster, filter better and give better water clarity, company points out. Included are Aquafloc 420, a nonionic type, Aquafloc 422, which may be used in potable water systems, and Aquafloc 425, which has an anionic form claimed to produce excellent results when floc is positively charged.

13—Bearing lubricant for the extreme operating conditions

Key to improved performance announced for Permawick 280 is an extreme pressure additive formulated for bearing use. The self-wicking lubricant is recommended by manufacturer, Permawick Co., for applications involving high or low temperatures, marginal and boundary lubrication, and high thrust loadings for vertical shaft positions. It is even reported effective in quieting stubbornly noisy bearings. In addition to improving operating characteristics of both babbitt and sintered bronze bearings, Permawick 280 shows greater resistance to degradation than many wicking lubricants or mineral oils, according to company reports.



14—Receptacles have dead-end contact feature

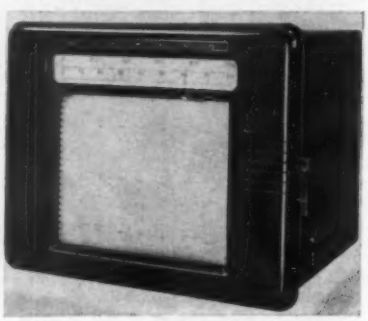
The CPSH Unilet of Appleton Electric Co. has a dead-end contact feature designed to confine arcing, if any, within plug combustion chamber. It thus affords dual protection, company says, by eliminating any live contacts exposed to hazardous area atmospheres. Unilets are designed for use with company's CPS explosion-proof plugs in atmospheres which contain volatile or inflammable fumes or explosive vapors. They are announced as UL approved for Class I, Group C and D locations. Each receptacle has a two-wire, three-pole circuit for single phase, 20 amp, 1 hp, 115 or 230 v, and 60 cycle a-c.

15—Extra-wide plastic sheet for tank linings

Extruded Penton sheet in 48-in. width rolls is offered by National Vulcanized Fibre Co. for lining tanks, vessels and other equipment. It is pointed out that these extra-wide rolls reduce application costs because more surface area can be covered with a single width — fewer seams, less welding time. Penton linings have a wide range of chemical resistance at elevated temperatures. Two standard sheet thicknesses are available: 0.040 in. and 0.062 in., the heavier designed for conditions of severe abrasion.

16—Combination recorder for pressure, temperature

Attractively styled, this electronic potentiometer recorder is self-contained and uses a constant voltage source instead of the conventional standard cell for standardization. It records one or more points of pressure and up to 23



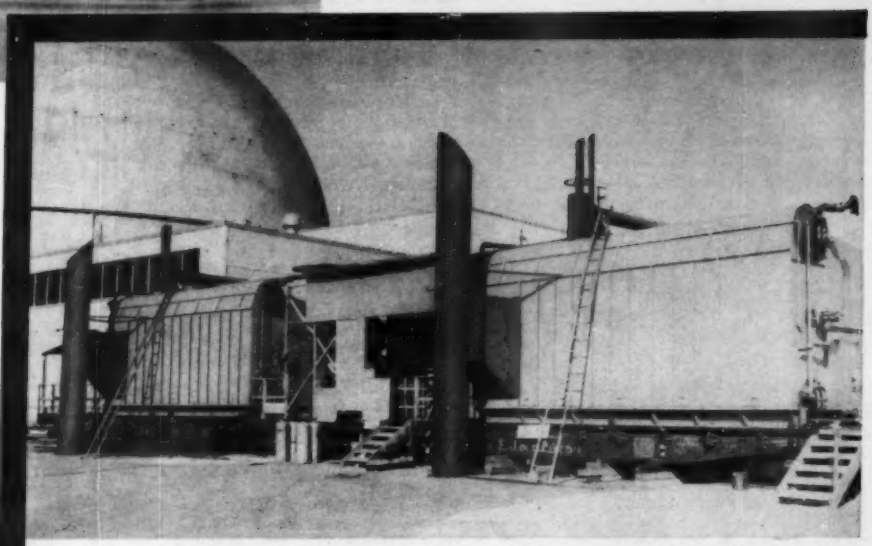
points of temperature. Developed by Wheelco Instruments Div., Barber-Colman Co., for use in connection with extruders, in the plastic industry, the flexibility of this recorder suggests other applications. The standard unit has a temperature range of 0-800 F; other ranges are available. Likewise, a variety

STEAM-TESTED

with multi-purpose

KEELER dk

package steam generators



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COMMONWEALTH EDISON CO.

— co-sponsor —
NUCLEAR POWER GROUP, INC.

designed and build by
GENERAL ELECTRIC CO.

Engineers-Constructors
BECHTEL CORPORATION

THE FIRST FULL SCALE privately financed ATOMIC POWER PLANT to go into operation in the United States.

Its power reactor is larger than any now operating or under construction in the country.

How do you check the nuclear unit steam lines and balance the turbine of an atomic power plant *without waiting* for the start-up of the entire Nuclear Reactor System?

This problem was solved quickly and economically at Dresden with *two Keeler Type DK Package Steam Generators.*

Two 55,000 lb/hr capacity Keeler DK's were fired-up five days after their arrival at the job site—*without removing them from railroad flat cars.* Fuel oil was piped direct to the burners through temporary underground lines from nearby tank cars. All conditions were otherwise arranged to simulate the eventual pattern of operation.

The two DK's were operated at capacities up to 68,000 lb/hr for considerable periods in the preliminary checking and later final testing of the plant's steam system, and balancing of the turbine.

Field reports indicated actual operating efficiency of the two Keeler units was *well above the 81.3% original guarantee*—in an application which ideally demonstrates the reason these DK units are described as *"multi-purpose steam generators"!*

Keeler is one of the nation's leading manufacturers of steam generators, with a complete line ranging from low cost package units up to 100,000 lb/hr and field erected units up to 200,000 lb/hr—for all fuels, all types of firing.

Nearly a century of versatility, economy and dependability are yours when you specify and insist upon Keeler Quality. *Write for full data . . .* there's a Keeler unit to efficiently serve your steam requirements.

The Seal of Quality in Water Tube Steam Generators

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Don't take chances on couplings

CHECK PUBLISHED MISALIGNMENT RATINGS BEFORE YOU BUY

Since misalignment is the basic problem that shaft couplings are designed to solve you'll find a published conservative misalignment rating (along with load capacity rating) for every Fast's Coupling. Compare it with the misalignment rating of any other coupling you are considering.
One further advantage of Fast's Couplings' misalignment ratings: You save money on installation because, knowing the ratings, you don't have to line up driving and driven elements with pinpoint accuracy. It's one more important reason why Fast's Couplings are the choice of more equipment manufacturers than any other gear-type coupling.
KOPPERS COMPANY, INC., 1209 Scott Street, Baltimore 3, Md.

KOPPERS **FAST'S COUPLINGS**
Engineered Products Sold with Service

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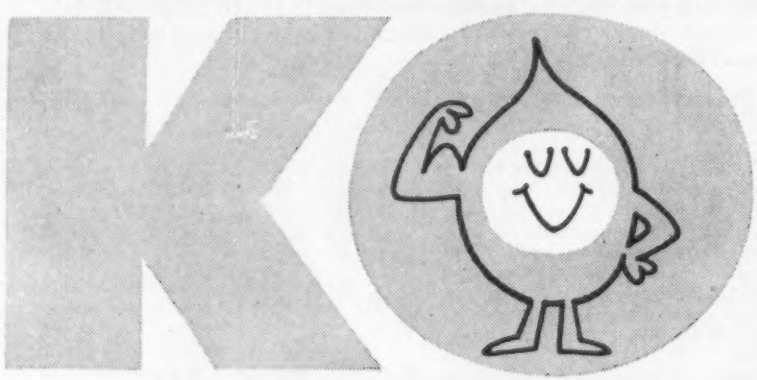
Knock out grease and dirt with



Safety Solvents!

KO9 cleans electric motors *fast*! Just immerse the running motor, remove it in minutes, as clean as new. No work for you...it actually cleans itself.

KO9 also cleans and degreases motors, generators, controllers, switches, panels, instruments, refrigeration lines. You name it...KO9 can clean it!

KO13 the amazing general purpose safety solvent, cleans almost anything...leaves surfaces smooth and sparkling! Write for literature today!

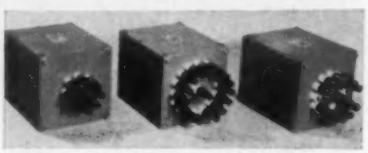
KOR CORPORATION 89 Box 485, Gary, Indiana

For more data circle 562 on Post Card

of pressure ranges are available even though standard recorder has a range 0-10,000 psig. Zero and span adjustment are provided for the pressure range of the instrument; this is independent of the temperature range. Bulletin F-9789 describes recorder.

17—Igniter control fires a network of gas burners

The Ignitifier is a multi-burner igniter control introduced by Protection Controls, Inc., for automatically firing up a network of gas burners in ovens, furnaces, boilers, etc. Features include high-speed ignition (up to 32 burners within 3 sec), and long-life contact-

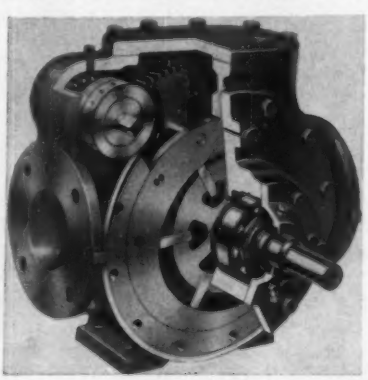


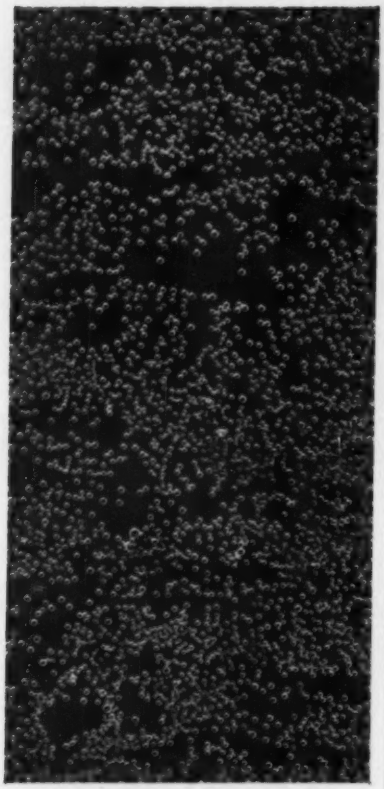
wiper switching design. When the unit is energized by a start button, a motorized double-end shaft rotates its wiping contact against a series of stationary contact tips — one for each burner in the system. This causes a high voltage impulse from ignition transformer to be fed to each pilot spark electrode. This ignites a gas-air mixture at each burner position — the gas-air mixture having been released with actuation of the start button. The unit repeats until all burners are ignited.

A timing unit can be incorporated to activate the motor at any desired intervals for continuous, intermittent, or variable timed ignition. Standard units are for operation at 5 or 6000 v (10 or 12,000 v available). Ignitifiers come in seven modular capacities from eight to 32 and components are interchangeable with higher capacity units.

18—Variable flow pumps let you "dial" the rate

With the Vari-Flow, you can "dial" desired flow rate from zero to full capacity without changing pump speed, according to Blackmer Pump Co., manufacturer. Thus, this pump can be powered with any standard-speed motor and provide advantages of variable speed drives. Manufacturer notes, also, that the Vari-Flo can reverse its flow while in operation simply by a turn of the dial — permitting evacuation of discharge lines without additional bypass piping and valves. There are three major areas of application. One is where





DEOXY-SOL REDUCES OXIDES

in boiler feed water yet adds no solids

– and that may be a good reason to select DEOXY-SOL for treatment of your boiler water. But it provides other advantages also.

DEOXY-SOL is a high efficiency oxygen scavenger, since it is a solution of hydrazine. And it raises the pH, supplementing any amine treatment.

Stocks in Newark, N. J., Chicago, Ill., Los Angeles, Calif.

Write for informative Bulletin BW.

Fairmount
CHEMICAL CO., INC.
136 Liberty Street, New York 6, N. Y.

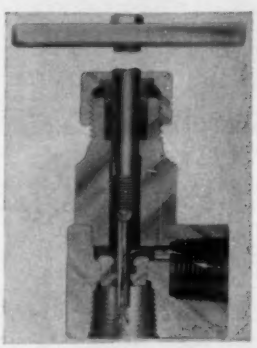
For more data circle on 563 Post Card

a change in flow rate is required to meet varying delivery conditions, such as filling storage tanks and drums with the same pump operating at successively lower capacities. Another involves a change in flow rate to meet a varying liquid condition, such as viscosity, as in unloading heated tankers of high-viscosity liquids like molasses. A third use is in liquid proportioning.

The Vari-Flo is currently offered in 2-, 3- and 4-in. sizes, providing capacities to 450 gpm, designed to handle liquids up to 85,000 ssu, operate at a maximum differential pressure of 100 psi. There are four types of pumps in each size. Two are external ball-bearing units with mechanical seals, one fitted for handling commercial solvents. The other two are packing-gland pumps for higher temperatures and viscosities; one is offered with steam-jacketed heads. Full information is in Bulletin 600.

19—Control valve for fine metering of liquids and gases

With the Micro-Flow Valve a flow coefficient as low as 0.003 to zero can be controlled linearly over a steam travel of 5/8 in., according to The General-American Valve Co. Higher ranges are also



standard. At 5000 psi the Micro-Flow Valve can be throttled from 3 ccpm, to 5 gpm, it is stated; at lower pressures the valve has been used to deliver as little as 10 drops per hour. Pressure ratings are to 10,000 psi. Clog and vibration resistance are obtained by restricting all flow to a triangle-shaped orifice. Standard materials are carbon steel, stainless steel or bronze. Air-diaphragm actuated units are available for 3 to 15 psi air supply. Prices start around $43.00.

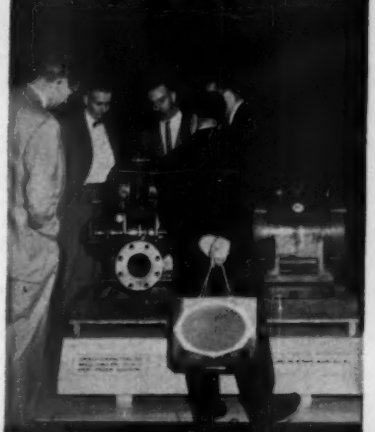
20—Spray coating gives plus protection against corrosion

Exceptional protection and good weathering, as well as decorative properties and no on-the-job mixing, are announced for Fiberglas Flake Protective Coating, a spray-applied coating developed by Owens-Corning Fiberglas Corp. It will be available to industrial users in pilot plant quantities. A spray gun unit for applying it has been developed by the DeVilbiss Co., and trained applicators are available. The coating is suggested for use where corrosion is a problem, as in storage tanks, jackets for stack insulation, ducting of chemicals, and concrete sewer lines. Also foreseen are use as a liner for concrete flooring and as a water sealant for concrete walls.

The product is described as a homogenous mixture of Fiberglas Flake, resin, fillers, accelerator and pigment (if

WHAT'S BUILDING UP IN

PUMPS AND COMPRESSORS?



Often regarded as the "heart" of a system, pumps and compressors merit frequent re-evaluation to determine that you are using the right machine for a specific application.

Listening to the "heartbeat" of pumps and compressors can best be done at the Power Show, where you can ask questions, investigate and compare, get first hand answers from the manufacturers themselves. There you'll also see a broad line of other power and allied equipment.

At the Power Show you'll be in direct contact with manufacturers, enabling you to get specific, direct, authoritative answers to your questions. Only at the Show will you see more than 250 leading suppliers' products, all conveniently grouped together.

Make sure you're there. Everyone else will be!

2448

24th NATIONAL EXPOSITION OF POWER & MECHANICAL ENGINEERING

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NEW YORK COLISEUM
NOV. 28—DEC. 2, 1960

MANAGEMENT: INTERNATIONAL EXPOSITION COMPANY
480 Lexington Ave., New York 17, N. Y.

NEW Pratt CYCLONE STRAINER
Eliminates Manual Cleaning
Costs Less to Install

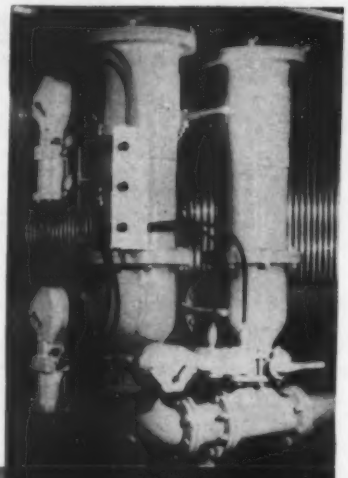
The new Pratt Cyclone Strainer eliminates the manual cleaning usually associated with this type of equipment. Both cleaning and backwashing operations are completely automatic and can be accomplished in seconds.

Unique design simplifies piping, saves space and installs for far less than ordinary designs.

Patented "Cyclone" action keeps larger particles away from basket—keeps strainer "on the line" longer.

Features rubber seat butterfly valves for longer life and positive action. Manual or automatic valve operators.

Write for details.



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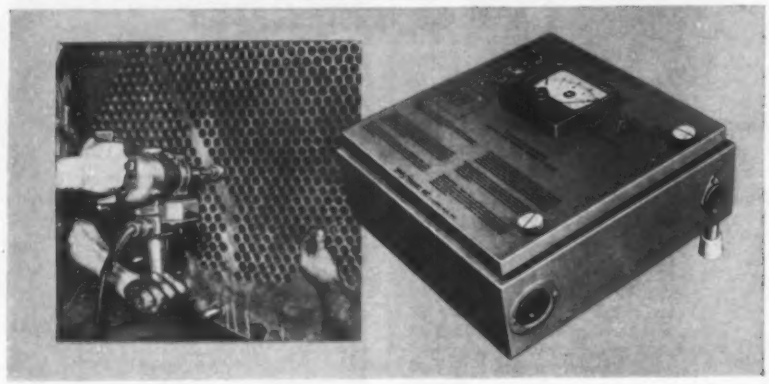

Your Motor + Wiedeke Torque Control = Increased Tube Rolling Production

Save the cost of a new motor! New Torque Control Instrument for rolling ¼" through 4½" tubes in boilers, condensers and similar heat transfer vessels—operates with any Universal Reversible Electric Tube Rolling Tapper or Motor. Adjustable time cycle matches operator's dexterity.

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The Gustav WIEDEKE Company
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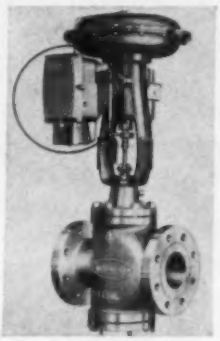
desired). According to manufacturer, a 20-mil thick coating has 50 layers of Fiberglas Flake — roughly the equivalent of 50 coats of paint in one application. Use of the flake with resin reinforces the coating by minimizing shrinkage and increasing impact resistance. In addition, crawling is claimed impossible because of the high shear force existing between layers of flake and resin as applied. Pinholes are said to be eliminated by isolation of air bubbles or voids with many layers of flake glass, and sagging of vertical surfaces eliminated by the shear force between flakes. Surface haze is reportedly no problem because the flake forms an air carrier without addition of haze forming resins.

21—Electropneumatic positioner has performance advantages

Developed by Mason-Neilan Div. of Worthington Corp., Model 8010 is said to permit combining advantages of electronic controllers and power and



smooth throttling action of pneumatic control valves. It directly compares valve stem position with controller output signal to achieve dynamic response and positioning accuracy. The positioner employs a large, stabilized, magnetic force motor to supply high force changes and a high-capacity air relay, for fast stroking speed. The electrical circuit is adaptable to presently available electronic controllers.

22—Marking kit for identifying the pipe lines

Step-by-step instructions for setting up a complete, uniform marking system for pipes of all sizes are provided in a pipe marker kit introduced by W. H. Brady Co. It tells which pipes must be marked for maximum safety, where markings should be located to speed tracing and prevent errors, and it lists ASA requirements calling for legend-plus-color identification. Kit contains a 6-pp planning guide, samples of markers for testing on actual temperature and environmental conditions. It is available free to qualified power engineers.

23—Aluminized gloves resist heat and flames

Designed to reflect 90 per cent of all radiant heat in work where high temperatures are involved, these gloves are suggested for welding and cutting operations, furnace work and similar operations. They are produced by Air Reduction Co., Inc. Backs and thumbs

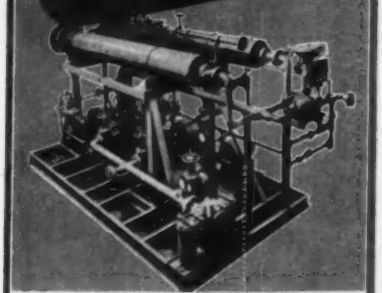
save on installation and maintenance

with

EAGAN

pre-packaged

FUEL OIL PUMP and HEATER SETS



Use an Eagan "pre-packaged" fuel oil pump and heater set for the preparation of heavy oil for combustion. You save time and money because units are completely assembled, ready for immediate installation. Only connections to oil and steam supply, burner, by-pass and relief lines have to be made and you avoid the combustion difficulties so often caused by field assembled combinations.

Here are additional benefits Eagan gives you:

- **Generous reserve capacity, at least 50% over peak burner demand, allows for eventual wear and future demand increases.**
- **Maintenance is easy and at a minimum. Parts requiring service are easily accessible.**
- **"Honest", solid construction, excellent engineering assure long life, trouble-free operation.**
- **Compact units save space.**

EAGAN fuel oil pump and heater sets heat to 300° F, pump to 400 psi and have capacities to 3000 gph. Single or duplex units are available for steam or electric drive. Duplex "electro-steam" sets provide for electrical failure by incorporating one steam pump and one electric motor driven pump. Other EAGAN sets can be made to your special requirements.

Write, wire or call for further information or let us bid on your job.

WALTER H. EAGAN CO., INC.

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Mfrs. of condensate, boiler feed, turbine, centrifugal and proportioning pumps and fuel oil pump and heater sets.

Pump Specialists Since 1920

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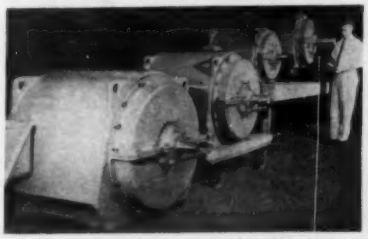
are aluminized asbestos — a combination of asbestos and a heat resistant fabric, Scotch-Shield. Extremely flexible, this material is described as light and fully insulating and not subject to cracking or peeling even under severe conditions. The gloves will come in three styles: a five-finger carpincho leather glove; a one-finger mitten of green heat-resistant leather; and a five-finger glove of green heat-resistant leather. All styles are available either lined or unlined.

24—Squirrel-cage motors are rated 250 through 1000 hp

Announced by Wagner Electric Corp. for heavy duty industrial applications, these large motors feature compact, smoothly contoured, steel plate enclosures. Four lifting eyes are integral parts of the frame ends. Mounting space required is reduced by positioning the feet under the overhang of the frame. Flat steel endplates are built in two sections, facilitating disassembly for bearing inspection. The drip-proof enclosure has ventilating openings so located and shielded as to provide essentially splash-proof protection. Available voltages are 440, 550, 2300 and 4160 v, 60 cycles. All ratings can be supplied with full load speed of 3500, 1750 or 1160 rpm; 870 and 690 rpm motors are available through 700 hp, 575 rpm through 500 hp.



25—Pipe, bolt machine features quadra-type diehead

The Speed King 4-in. pipe and bolt machine, designed by Beaver Pipe Tools, Inc., features wrenchless chucks, four speeds, throw-out fixtures so it can be used as a makeup machine, light weight so it can be moved to job site (it weighs only 980 lb, is trailer mountable). The machine has option of wheel and roller or knife type cutoff, and can be used for grooving for couplers, beveling for welding, or cutting and stripping saran. It can thread 1- through 4-in. pipe using two dieheads and two sets of dies, company reports. Using a quadra-type diehead on a 4-in. machine,

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If your company and your job depend on power generation, you should know all there is to know about information systems, strip-chart recorders, analog computer controls and similar components of an efficient power system.

You know the part they play in high-efficiency power generation, and you can build and supplement this knowledge at the Power Show. Exhibitors include manufacturers of products like automatic pH controllers, control valves, flow controllers, pressure, vacuum and absolute pressure controllers—PLUS a broad line of other power and allied equipment.

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NOV. 28—DEC. 2, 1960

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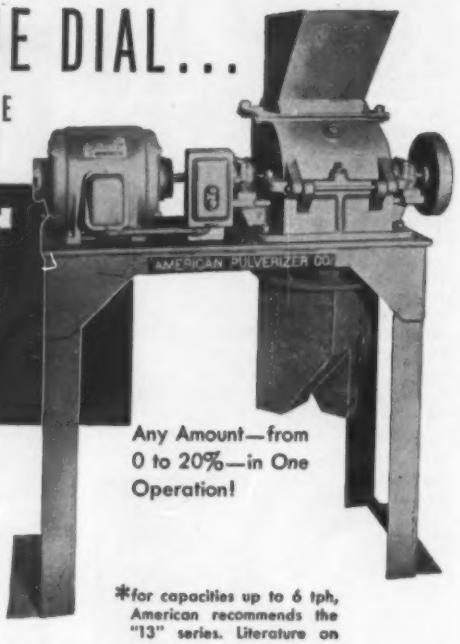
WITH NEW ADJUSTABLE SAMPLING HOPPER



Any Amount—from 0 to 20%—in One Operation!

Does the job so quickly, efficiently, there's no loss of moisture content in sample.

FAST Up to 1 tph (Model 15 x 9); ½ tph for Model 9x9 (shown).*

EFFICIENT Once-through and the job's done!

LOW COST Practically no wear to an American Sample Crusher.

*for capacities up to 6 tph, American recommends the "13" series. Literature on request.

American PULVERIZER COMPANY

1431 MACKLIND AVE., ST. LOUIS MO.

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MANY FAST'S HAVE BEEN WORKING LONGER THAN YOU

It's a fact. There are plenty of cases where Fast's Couplings have been in service 20 to 40 years. And some of our more enthusiastic engineers say a Fast's should last forever if it's properly applied, installed and lubricated. Whatever opinion you accept, you can bet Fast's Couplings will give you the same smooth-running, low-maintenance, long-lived performance that makes them the choice of more equipment manufacturers than any other gear-type coupling.

For example, Fast's Coupling No. 1347, shipped in July, 1922, is still in service—and the customer is just ordering his first spare coupling 38 years later.

KOPPERS COMPANY, INC., 1209 Scott Street, Baltimore 3, Md.

KOPPERS **FAST'S COUPLINGS**

Engineered Products Sold with Service

For more data circle 570 on Post Card

the range of 2½ through 4-in. can be threaded without changing dies or dieheads.

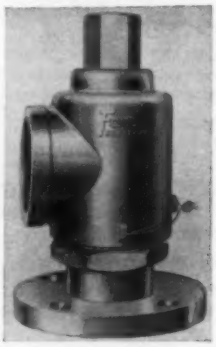
26—Vibrator conveyor for bulk movement of coal

Fabricated from iron and steel, by The Cleveland Vibrator Co., this deep tray conveyor is designed to handle any size coal from 5-in. egg to ⅜-in. slack. Pneumatic vibratory unit located under-

neath tray is designed to move coal forward with rapid vibrations, without shattering coal or causing excessive dust and chipping. Conveyor may be either hung with shielded suspension springs, as shown, or floor spring mounted, isolating vibration from supporting structure. Springs provide flotation rather than amplify vibratory impact. According to company, conveyors can be installed in inaccessible locations with automatic lubrication and adjustment controls installed any distance from conveyor itself.

27—Safety relief valves for liquids, gases, vapors

Precise blowdown ring control for gases and vapors, and safety relief for liquids in a wide range of applications where maximum pressure is 300 psi are announced by Farris Engineering Corp.



for valves in the 1870 Series. Featured are a one-piece stainless steel body and stainless steel disc which contains inlet pressure without other joints or gasketing — construction designed to provide a leak-proof seat. Valves are available with tungsten steel springs for temperatures to 800 F, with choice of plain cap, packed cap and lever or open lever. Inlet connections include male screwed or 150- and 300-lb raised face flange types. Catalog FE-138 gives full information on the valve.

28—Monitor-alarm system can control 30 channels

Signal Sentry, an all solid-state monitor-alarm system less than 42 in. high and portable, is designed by Franklin Electronics Inc. to verify condition of 30

"I got a big raise!"

"I SAVED OUR COMPANY THOUSANDS OF DOLLARS

when I suggested we have all our **SHELL and TUBE HEAT EXCHANGERS and CONDENSERS** repaired and retubed by CONDENSER SERVICE & ENGINEERING COMPANY."

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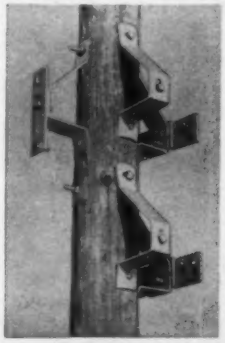
stations with a reputed accuracy of one part in a thousand. It is intended for process control, reactor and power generation, other applications. Signals from transducers representing temperatures, pressures, liquid flows, displacements are fed to alarm system. Allowable or permissible values for each station are punched in advance into IBM card. When card is inserted in front of Signal Sentry, it checks each station against prescribed values and provides audible and visual information and electrical outputs when a station is about to exceed or has exceeded its allowed tolerance. According to company, all 30 channels are examined in less than 0.3 sec. Brochure 750 gives details.

29—Cluster brackets mount transformers faster, easier

Minit-Mount, a simple adaptation of the pole-bolt mounting principle, is designed to mount transformer clusters, capacitor banks and line-type oil circuit reclosers in a fraction of the time required by most methods. Also, according to Graybar Electric Co., U. S. distributor for the developer, Minit-Mount gives



more unobstructed working space between transformers — almost 3 ft. The brackets install with a minimum number of holes to be bored through the pole. Three of the largest size transformers with 12-in. lug spacing can be mounted with only two through bolts. Four through bolts are used to mount three of the largest 167-kva transformer clusters, or any size transformer with 24-in. lug spacing. Only one man — not a crew — is needed to handle the 9-lb Minit-Mount, it is noted, and the unit has a built-in safety factor up to 400 per cent.

30—Manifold valve is three valves in one unit

The P-727 Series Valve of Circle Seal Products Co., Inc., is specifically designed for use with differential-type measuring, recording or transmitting instruments in chemical plants, refineries, pilot plants. One variation provides a bleed hole that vents both instrument ports to atmosphere when balancing valve is open. Another variation replaces the basic five-valve assembly. Of brass and 303 stainless, with operating pressures from 0-2000 psi, the P-727 is reported suitable for systems containing air, alcohol, ammonia, argon, helium, hydrogen, hydrocarbons, base oils, natural gas, etc. Because of three valves in one body, several fittings are eliminated during installation. According to company, valve is maintenance-free, does not require valve seat replacements or

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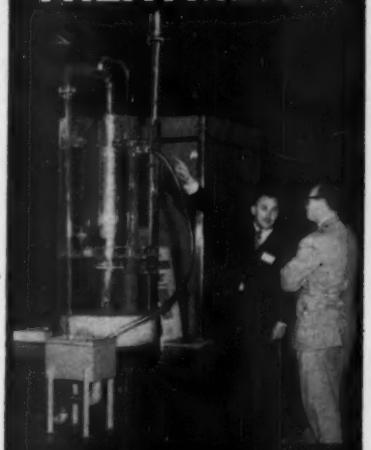
WATER TREATMENT!



Is good boiler housekeeping in your plant beset by sludge, scale and corrosion? Are these enemies of efficiency increasing downtime and maintenance costs, fighting company profits and your own career?

The Power Show can help you find better ways to fight back. It can help you keep your company's profits growing and your own job on the upgrade by keeping you up-to-date on water softeners, demineralizers, dealkilizers, filters, deaerating heaters and clarifiers — PLUS a broad line of other power and allied equipment.

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480 Lexington Ave., New York 17, N. Y.

operating adjustments. O-rings set in grooves in diameter of valve plugs are designed to prevent interport body leakage.

31—Turbine pump motor is water cooled and lubricated

These motors rated 30 to 250 hp, 60 cycle, 1800 rpm, for 10-in. or larger well casings are designed by Westinghouse Electric Corp. for continuous submersion in water at a maximum of 40 C for deep wells, booster or process applications. With water used as the cooling and lubricating agent, no pressure system is required, and there is no oil or other fluid which can contaminate well water, manufacturer notes. The large water filter serves to keep out foreign matter, and large surface area to reduce danger of clogging with sand and silt. Shaft seals in the bracket force the water to travel along the shaft and through the filter, and an epoxy coating on the windings protects against any silt that may enter.

32—Draft gage manifold designed for easy cleaning

Cleaning of fly ash and combustion residue from draft gage lines is made easy by Republic Mfg. Co.'s draft gage manifold valve for pressure boiler applications. Disconnecting of lines is not

necessary. The unit, singly or in multiple, is permanently connected to compressed air supply, it is noted, and the gage line is shut off during blowing off of draft line, without affecting the gage. A removable plug permits zero check, and calibration of instruments. Any number of units may be manifolded, with separate unit for each pointer. Bulletin 560 gives details.

33—Temperature detectors for air compressor discharge

These temperature detectors made by Thomas A. Edison Industries are designed to measure discharge temperatures of air compressors at various stages. Model 246 made of 403 stainless steel has a ¾-16 UNF-3 mounting thread and is designed to withstand pressures of 5000 psi. Model 247 is of similar configuration, but made of 9010 copper nickel alloy for measuring cooling water temperatures (including sea water) or lube oil temperature. Detectors may be connected to indicators, recorders or Edison Omniguard Monitors to read temperatures, or if desired, automatically shut down compressor should any stage overheat.

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101 pages of technical data and useful information. Gives theory and application of pH control. Describes full Taylor line.

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410 STEVENSON LANE • BALTIMORE 4, MD.

For more data circle 573 on Post Card

NEW DE-LINE annunciator has **70% MORE ENGRAVING AREA** for more precise trouble legends

Scam De-Line annunciators, your systems' sentry, now offers the new MAGNA-PLAC nameplate which provides 70% more engraving area.

The MAGNA-PLAC nameplate gives the engineer increased space to more accurately describe condition variations or to employ larger characters for greater visibility. It is interchangeable with standard Scam nameplates and optionally available *without extra charge*.

Other De-Line features include side or stack mounting for practical, *economical* system expansion; a single plug-in relay for both normally open *or* normally closed contacts; and sequence options *after* installation.

Yes, continuous product improvements such as MAGNA-PLAC, flexible application, ruggedness and reliability are what make De-Line the engineer's annunciator.

Complete Monitoring Systems for Industry

SCAM®

INSTRUMENT CORP.
Dept. A, 1811 W. Irving Park Rd.
Chicago, 13, Ill.
Representatives in Principal Cities

WRITE FOR MORE INFORMATION on De-Line MAGNA-PLAC. Just sign and attach coupon to company letterhead.

Name .....

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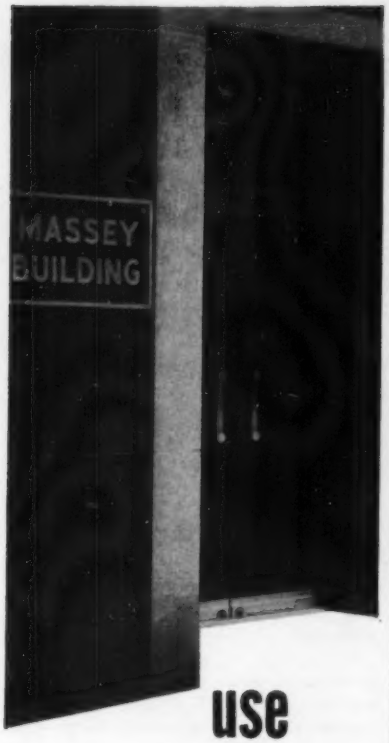

use this door-way

TO 15 MILLION TONS OF "PRESCRIPTION COALS"

A network of Massey sales offices and sales representatives, reaching from Florida into Canada, is linked at all times by teletype and telephone to Massey mines and processing plants.

RESULT: efficient service and prompt, dependable delivery to fill your "prescription" from Massey's 21 famous brands. Next time coal is your concern—call on Massey's 15 million ton annual output.

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COAL CO., INC.

General Offices: Massey Building
Richmond, Virginia
CINCINNATI CHICAGO
DETROIT CLEVELAND
TORONTO

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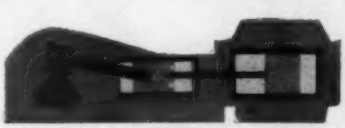
34—Flow tube has low head loss, high recovery

Lo-Loss Flow Tube is announced by Burgess-Manning Co. as a differential producer for accurate measurement of

flow, with lowest head loss and highest recovery. With its short, compact length, installation can be made on horizontal, vertical or inclined lines. For use with clear water, sewage, sediment bearing liquids, trade wastes, air or gases, tube is available in cast iron, bronze, stainless steel, plastic or any specified material, and can be formed, cast or fabricated to meet requirements.

35—Lighting control has time-delay feature

The Lamplighter (Series 15,000) of The Acme Wire Co. is a photoelectric lighting control with injection molded plastic cover and base to provide high dielectric strength. A series of exterior ridges facilitates handling and installation, while a twist-lock base, conforming to EEI-NEMA standards, fits standard receptacles. Although a non-fused model is available, Lamplighter offers fuse protection in case of overloading, as well as protection against surges and lightning. Light level, adjustable externally from base, can be set from one to 10 cf. Time-delay feature prevents turn-off from light sources such as lightning, automobile headlights.



ANSWER

to Worthington Hidden Value Puzzle

The fictitious "hidden value" on the back cover is, of course, the "Full Floating Wrist Pin" in the piston. This construction is found only on light duty compressors with single acting cylinder construction.

Because all Worthington horizontal compressors are heavy duty machines, they are built with the crankshaft, connecting rod and crosshead linkage system illustrated above. It changes rotary shaft motion to linear piston motion without side thrusts on the cylinder walls. Thus wear is reduced and compressor life increased. Worthington Corporation.

MINIATURE 2-WAY RADIO SYSTEM lets you SPEAK and be HEARD under ANY NOISE CONDITIONS!

the SEISCOR TELEPATH . . . is a portable industrial-type communications system that becomes a part of your wearing apparel. Crystal-controlled circuit plus noise-cancelling mike and earphones make it the best way to communicate in poor visibility or high noise conditions!

- Fully transistorized printed circuit
- Crystal-controlled superheterodyne receiver
- Crystal-controlled transmitter
- Long battery life
- For any single frequency between 20-55 mc., A.M.
- No license required on 27 mc. units.
- Priced from $350.00 per unit.

MODEL HR Hardhat with built-in transceiver, antenna, earphones and mike. High and low noise level models available.

MODEL BR Belt-clip transceiver and headset with built-in antenna, earphones and mike. High and low noise level models available.

Let Seiscor Engineers analyze your short-range communications problems. Example: Special units have been designed into protective clothing for crash-crew fire fighters.

FIND OUT TODAY HOW TELEPATH CAN IMPROVE YOUR SHORT RANGE COMMUNICATIONS!

Write for name of nearest TELEPATH dealer, and complete information on versatile TELEPATH communications.

SEISCOR
A DIVISION OF SEISMOGRAPH SERVICE CORPORATION
BOX 1590, TULSA, OKLAHOMA

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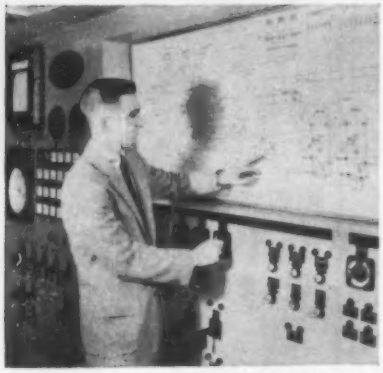
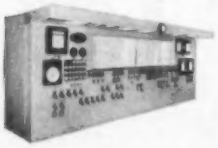
METROPOLITAN EDISON uses...

ILLCO-WAY ionXchange





This graphic control panel, designed and built by IWT, not only has all the controls but also a schematic diagram with indicating lights to show the action at all points.

Blowdown Unnecessary in a New High-Pressure Once-Through Boiler

The Portland Station of Metropolitan Edison Company at Portland, Pa., has a once-through type of boiler for which the purity of make-up water is particularly critical. IWT Mixed-Bed* De-Ionizers were selected to purify the make-up water to the required degree — and they succeeded, even beyond expectations. The total silica in the boiler water is consistently maintained at 0.1 ppm or less. From the Mixed-Bed* De-Ionizer, the silica is normally below 0.01 ppm and log sheets frequently show analyses as low as 0.003 and 0.005 ppm. With such a high purity of make-up water, blow-down is entirely unnecessary for extended periods of time. All IWT equipment — including chemical feeders, gravity filters, cation and anion exchangers, a vacuum degasifier, and the Mixed-Bed* De-Ionizers — are controlled *automatically* from the graphic panel shown above.

* U.S. Pat. Nos. 2,605,084, 2,771,424

PIONEERING EXPERIENCE

Such outstanding performance is the result of intensive early and continuing experience, by Illinois Water Treatment Co., with the special problems of ion-Xchange. *To benefit from this leadership, call your IWT representative.*

ILLINOIS WATER TREATMENT CO.
840 CEDAR ST., ROCKFORD, ILLINOIS
NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Ont.

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Tube Cleaners

Clean tubes and pipes from ½" to 12" I.D.
THOROUGHLY
QUICKLY

ROTOJET Model 512 Air-driven Motor, universal joint, swing-frame head, and solid brush.

Our large stock of Rotojet air-driven and water-driven tube cleaners, accessories, and repair parts for straight and curved tubes, pipes, and transfer lines is available to meet most requirements without delay. Tube cleaner specialization for 43 years assures satisfactory results from any Rotojet equipment we recommend. Send for Bulletins J-410 and R-105. For quick action wire or phone, HUmboldt 3-0570.

ROTOJET Junior Model S32 Air-driven Motor, universal joint, cone cutter.

ROTOJET Model C-525 Air-driven Motor with swing-frame head and universal joint.

ROTOJET Model C-526 Air-driven Motor with pivot head and universal joint.

ROTOJET Junior Model C434 Air-driven Motor, flexible coupling, expanding brush.

ELLIOTT COMPANY – ROTO PLANT
Tube Cleaner Specialists Since 1910
147 Sussex Avenue, Newark, N. J.

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8900-HC

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Don't let corrosion problems get you down! *Prevent* costly electrolytic corrosion in buried or submerged ferrous structures with pre-engineered Harco Cathodic Protection systems. Let the Harco Man show you how a truly nominal investment in H.C.P. will produce substantial savings in maintenance and equipment replacement costs. Harco . . . leader in the field of cathodic protection . . . offers complete job-engineered systems, including necessary field testing, drawings, materials and installation by competent Harco crews . . . plus periodic inspection or maintenance, as required. Call or write today for complete information . . . you'll be glad you did!

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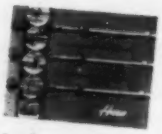

Send for your Harco catalog *today!*

THE HARCO CORPORATION

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KULJIAN KNOWS POWER . . .

Industrial or utility . . . thermal, hydro, internal combustion or nuclear . . . Kuljian power specialists have designed, engineered and supervised construction of more than one hundred power installations throughout the world. From project feasibility report through initial operation, Kuljian complete engineering services—fully coordinated under one management responsibility—assure long term savings plus initial economies.

For new power plants and facilities . . . or modernization and expansion . . . Kuljian offers services to meet all your engineering and construction requirements. Write for brochure detailing complete Kuljian services.

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Why does Island Creek coal so often lower the cost per 1000 pounds of steam?...

It's Precisioneered*

An Island Creek technician uses the optical pyrometer to determine ash fusion point of a coal

* PRECISIONEERING at Island Creek is many things. Essentially, it is starting with superior seams of eastern coal . . . and preparing it to the exact specifications your burning equipment requires to produce steam at the lowest net cost per 1000 lbs. This involves the use of precision engineering techniques in the most modern preparation plants. It involves strictest laboratory controls. It involves far-reaching engineering service and evaluation studies. From start to finish it involves the career company attitude that has made Island Creek a leader to whom other leaders may look—with confidence. We'd welcome a chance to get down to net costs—with you and your plant people. Write. Or phone. No obligation, of course.

ISLAND CREEK
Precisioneered Coal

You can depend on Island Creek . . . a career company dedicated to coal

Island Creek Coal Sales Company, Chafin Building, Huntington 18, West Virginia • Chicago • Cincinnati • Cleveland • Detroit • Greensboro • New York • Pittsburgh

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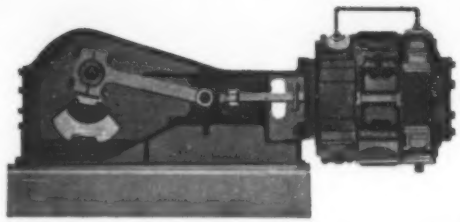


HIDDEN VALUES?

Are they all in Worthington Horizontal Compressors?

Frankly, they're not. And we're glad! One of the "hidden values" listed below we'd hate to sell—see if you can tell which one it is. (Correct answer on page 127.)

On the other hand, we're extremely happy to be selling horizontal compressors with the other 24 "hidden values" built in. (Not everyone does.)

Frankly, we could drop many of these and 99 users out of 100 might never know it. But the 100th could suffer untold expense . . . so we keep them all for everyone. To buy these "hidden values", please contact your local Worthington representative next time you specify a compressor. Worthington Corporation, Compressor and Engine Division, Buffalo, N. Y. 36-10

SALES AND SERVICE INTEGRATION recognizes kinship of one to the other. One man administers both.

MAGNAFLUX AND MAGNAGLO inspections are widely used to expose surface imperfections.

ULTRASONIC TEST — an advanced method of examining certain critical parts for internal quality.

ACCESSIBILITY — valves, packing and main parts are easily observed and reached by operators.

ADJUSTABLE ROLLER MAIN BEARINGS feature low friction losses which help to extend compressor life.

INTEGRATED DIV. includes foundry, manufacturing, sales, service and engineering in one location.

FEATHER VALVE — industry's preferred compressor valve—is efficient, quiet, and low in maintenance.

CAPACITY CONTROL —choice of simple bypass, through dual to complex sequential control systems.

FLEXIBILITY — oil or non-lube; single or multi-stage; Worthington MVD, direct or geared drive.

PARCO-LUBRITING of critical wearing surfaces completely eliminates most start-up scuffing problems.

ONE-PIECE FRAME includes built-in housing with full foundation support to minimize stresses.

2000 CRAFTSMEN, these units built by same men who design and build large 5000 hp, 15,000 psi units.

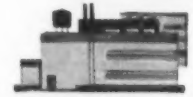
KOLENE PROCESS removes impurities from crankpin bearing shell that weaken bond to babbitt.

OPTIC COMPARATOR is used to check connecting rod bolt threads for uniform angles, lead and form.

FACTORY ASSEMBLY and shop run-in on air insure proper operation and reduce installation costs.

FINISHED GROUND BEARING SHELLS provide crankpin positive full-contact backing for long life.

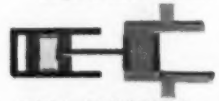
COMPOSITION TEST determines constituents of molten iron in each ladle before any casting is poured.



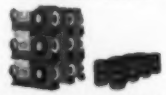
$1,000,000 ADDITION TO LABORATORY assures sound equipment designs based on actual research.

COUNTERWEIGHTED CRANKSHAFT eliminates vibration and insures a smoother operation.

DISTRIBUTORS — over 200 in major markets give local supply and close contact with Worthington offices.



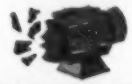
FULL-FLOATING WRISTPINS in piston give minimum piston and cylinder wear and reduce maintenance.



STOCKING PROGRAM standard air and gas gathering units are kept in stock to give short shipments.

PROFILOMETER inspection of highly finished parts assures easy break-in and long life.

THERMODYNAMICS SECTION analyzes special application to size unit and determines performance.



DESTRUCTION TEST of complete compressor cylinders verifies engineers' design calculations.

WORTHINGTON